

# **Twenty-One Mile Creek Watershed: Source Water Protection Plan**

Resort Municipality of Whistler



**WHISTLER**

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## 1. ACKNOWLEDGMENTS

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## **2. SOURCE WATER PROTECTION PLAN (SWPP) EXECUTIVE SUMMARY**

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### **2.1 Overview**

This Source Water Protection Plan (“SWPP” or “the Plan”) provides the framework for the implementation of actions that will lead to enhanced protection for the availability and quality of, the Twenty-One Mile Creek surface water source used by our Resort Community for drinking water supply. Twenty-One Mile Creek watershed represents between 45-55% of RMOW’s water supply. The primary objectives of this plan are to ensure that exposure to unacceptable concentrations of contaminants in the source water are minimized, to implement procedures and policies that will support the long-term sustainability of the surface water resource, and to maintain public confidence in Whistler’s drinking water quality. This SWPP is required as a condition of Resort Municipality of Whistler’s (RMOW’s) permit to operate the Twenty-One Mile Creek water supply, as issued by the Vancouver Coastal Health Authority (VCHA)

On July 24, 2015 VCHA provided a letter to RMOW that outlined in general terms the Drinking Water Officer’s understanding of the Twenty-One Mile Creek watershed, its land use, its infrastructure and suggested the major areas of consideration that should be given to protect the water supply. These areas of consideration have been addressed in this Plan, and the letter is included as Appendix D. Protection of the Twenty-One Mile Creek surface water supply resource will be achieved by continually identifying and minimizing contamination risks within the watershed. The potential for future contamination will be minimized by implementing one or more risk mitigation actions to address identified hazards. These actions may include amendments to our community planning processes, raising public awareness and fostering community support regarding the need for stewardship of this surface water resource, preparation of contingency plans to ensure appropriate response to any potential contamination events, specific actions to address identified risks, and ongoing monitoring within the watershed. Any unforeseen or emergency event (for example extreme flooding, aircraft crash) that occurs outside of the considerations of the SWPP results in referral to the RMOW Water System Emergency Response Plan.

This Plan is intended to be a “living” document, evolving to reflect policy changes, input from stakeholders, new information regarding surface water conditions or contamination events, and new or planned activities within the watershed. To facilitate stakeholder involvement, the Twenty-One Mile Creek Technical Advisory Committee (TAC) was formed to guide the development and implement the risk mitigation actions documented in the SWPP. The TAC will provide input to the RMOW for the ongoing implementation and the annual review and amendments to this Plan. The proposed timeline and process for review and revision of the SWPP is outlined in Section 8.0.

In January of 2015 Urban Systems completed the Twenty-One Mile Creek Source Water Assessment (“Assessment”) report. The purpose of the report was to provide a summary of the

formal Assessment process and findings, including the identified hazards, risks, and preliminary risk management concepts for reducing risks to water quality in the Twenty-One Mile Creek Watershed at the source level.

The Assessment is the foundation document on which the Twenty-One Mile Creek SWPP is based and for now (until such a time as components of that text are fully incorporated into this document) is referenced frequently and should be referred to for additional detail on certain subject matter (see Section 5.0).

## **2.2 Twenty-One Mile Creek Watershed Land Use**

The Twenty-One Mile Creek Watershed area falls under the stewardship of the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO). Under the Sea to Sky Land Resource Management Plan (S2SLRMP), the Twenty-One Mile Creek Watershed falls within a Wildland Zone (WL #23). Appendix 7 of the S2SLRMP specifies direction for uses within this zone which includes recreation and refers to Section 4.6.2 for specific direction with respect to Water.

The Rainbow Lake Hiking Trail has been in existence for approximately thirty (30) years and is considered a day hike (to Rainbow Lake and back); although some overnight camping is known to occur.

“Overnight camping is discouraged, except for emergency purposes. New formal campsites will not be developed and signage will be used to inform hikers of appropriate camping locations outside of the watershed. Existing camping areas along the Rainbow-Madeley trail will be retained and may be improved to reduce environmental impact from campers. Future recreational development will focus on minimizing the potential for water contamination, such as upgraded toilet facilities, trail maintenance to reduce erosion, and public outreach on appropriate sanitary practices.”<sup>1</sup> See Appendix C Hazard 1.13b for more details.

“No public motorized access in Twenty-One Mile watershed. Horse and pack animals are not permitted within the Twenty-One Mile and Nineteen Mile Valleys.”<sup>2</sup> See Appendix C Hazard 1.12 for more details.

“No permanent commercial recreation facilities are to be constructed in Twenty-One Mile Valley. The existing tenure for a heliski operation in Twenty-One Mile and Nineteen Mile Valleys is recognized and will continue as the only motorized recreation tenure in the area, with no further expansion of the existing helicopter tenure, and no new motorized recreation tenures. The use of helicopters in and over this area is discouraged during the summer hiking months (June 1 to October 31). There will be no further expansion of motorized access in the area, in order to maintain the zone for quiet enjoyment by the public. Public motorized vehicle access

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<sup>1</sup> Sea to Sky Land and Resource Management Plan April 2008

<sup>2</sup> Sea to Sky Land and Resource Management Plan April 2008

is only permitted to Madeley Lake along the existing Callaghan FSR 04, and to access existing utilities infrastructure (e.g. waterworks, repeaters).”<sup>3</sup> In addition to maintaining the zone for quiet enjoyment of the public, not expanding the area to motorized recreation is in line with the water quality goals in Section 4.6.2 of the S2SLRMP “Meet or exceed existing community and/or local government standards” and with the general wish by the RMOW community to maintain a natural environment. See Appendix C Hazard 1.13b for more details.

Snowmobilers are not allowed to enter the watershed; however, this has been known to occur. MFLNRO has already approached Canadian Wilderness Adventures and local snowmobile clubs to inform users of the prohibition of snowmobiles in the watershed. See Appendix C Hazard 1.15 for more details.

“The exploration and development of minerals, aggregates, dimension stone, oil and gas and geothermal resources is permitted within this Zone, subject to recognition and accommodation of First Nations environmental, social and cultural values. Advanced exploration and mining activities will seek to minimize cumulative impacts and mitigate or reduce disturbance to First Nation cultural values and sites by maximizing the use of existing infrastructure.”<sup>4</sup>

### **2.3 Twenty-One Mile Creek Watershed Contaminant Sources**

“For the purpose of the SWPP a hazard is defined as the source of potential physical, biological or chemical contaminants or threats, which present risks to Twenty-One Mile Creek at the intake.

A hazard is something that has the potential to cause harm to a receptor, but may not (the receptor being Twenty-One Mile Creek). Risk is the product of the likelihood of a hazard occurring and the potential consequences to elements at risk (the receptor). Risk is a function of likelihood, exposure, the value of the receptor, and the sensitivity of the receptor to the hazard.”<sup>5</sup>

“A contaminant source inventory was completed as part of the Assessment and involved identifying and describing contaminant sources identified through literature review and field investigation. Because the emphasis of the assessment was on public health, particular attention was paid to hazards that may introduce contaminants that may have acute effects on health.”<sup>6</sup>

“The intrinsic (Natural) hazard identification summary (Section 3.4) identified historical, current and potential future natural hazards within the assessment area. These natural hazards may introduce contaminants to the drinking water source. Additionally, land use and human activity

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<sup>3</sup> Sea to Sky Land and Resource Management Plan April 2008

<sup>4</sup> Sea to Sky Land and Resource Management Plan April 2008

<sup>5</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section Executive Summary.

<sup>6</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 4.1.

(anthropogenic hazards) may introduce contaminants. Ultimately, these contaminants may present risk to the drinking water source due to their potential consequences of exposure.”<sup>7</sup>

For the Twenty-One Mile Creek Source both intrinsic and anthropogenic hazards pose a risk to the water supply availability and the water supply quality, however relatively speaking, the intrinsic risks pose a greater threat to the availability, and the anthropogenic risks pose a greater threat to the quality, of the source water supply.

#### **2.4 Risk to Availability of Source Water Supply**

There are two main source water indicators; turbidity and ultraviolet transmittance, the levels of which impact the availability of this source water supply to RMOW. Increased turbidity of the source water results from landslides and trail run off. The water supply treatment system is not operated under high turbidity conditions (automatic shutdown occurs at Nephelometric Turbidity Unit (NTU) >1). If episodes of high turbidity increase RMOW’s ability to supply water under normal, maximum day demand or fire flow condition could be jeopardized.

The major existing hazard in the watershed that threatens water supply due to their potential to result in high turbidity events, are the large naturally existing sloughing areas (sedimentation)<sup>8</sup>. The Work Plan in Section 3.0 describes action items for each of the sloughing areas, which are to be assessed in fall of 2015 in terms of how they can be engineered so as to mitigate slope failure.

The risk of major turbidity events effecting supply would greatly increase if there was a catastrophic wildfire with the potential to cause additional slope failures throughout the Twenty One Mile Creek Watershed. Wildfires could either be started by lightning or by humans. The Work Plan in Section 3.0 describes action items for mitigating wildfire hazard on an ongoing basis.

Trail run off is much less of a concern for supply effecting turbidity events, especially where concerted effort has been made to design Rainbow Trail to divert rainfall run off and stabilize the trail to meet the demands of foot traffic. MFLNRO and RMOW invested significant funds in 2012, 2013 and 2014 to stabilize sections of the Rainbow Trail. Notably numerous small wooden bridges were installed to cross smaller water courses, the three large bridges were repaired/replaced and a 700m section of trail was relocated out of a marshy area. One area of focus for future trail maintenance will be around Rainbow Lake, where the muddy trail crosses water courses running directly into Rainbow Lake. The Work Plan in Section 3.0 contains action items for the Rainbow Lake Riparian area which is to be assessed in terms of how the trail can

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<sup>7</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 4.1.

<sup>8</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 3.2.5.



best be designed to reduce water turbidity caused by foot traffic, protect the sensitive Riparian area and discourage swimming in the Lake.

Other identified turbidity hazards are summarized as actions in the 2015/2016 Work Plan in Section 3.0 or in the detailed tables of Appendix B and C.

## **2.5 Risk to Quality of Source Water Supply**

Pathogens which include bacteria, fungi, parasites and viruses occur naturally or are introduced into the watershed by humans and wildlife. Ultraviolet light deactivates protozoan and disinfection is designed to deactivate 99.9% of the protozoan present. The water supply treatment system is not operated under low Ultra Violet Transmittance (UVT) conditions (automatic shutdown occurs at < 85% UVT). Subsequent to UV disinfection, chlorine is used to deactivate viruses, and treatment is designed to deactivate 99.99% of viruses. These two (2) treatment barriers meet the minimum requirements under the Canadian Water Drinking Guidelines for Surface Water Treatment. If the number of pathogens known to cause illness in human's increases, RMOW's ability to supply safe drinking water could be jeopardized, since treatment of the raw water source is not 100%.

It is important to note that the water treatment system does not include filtration, a treatment exemption that relies on RMOW maintaining a raw water source low in pathogens. To invest in this additional level of treatment would result in a capital project of \$20 - \$50M.

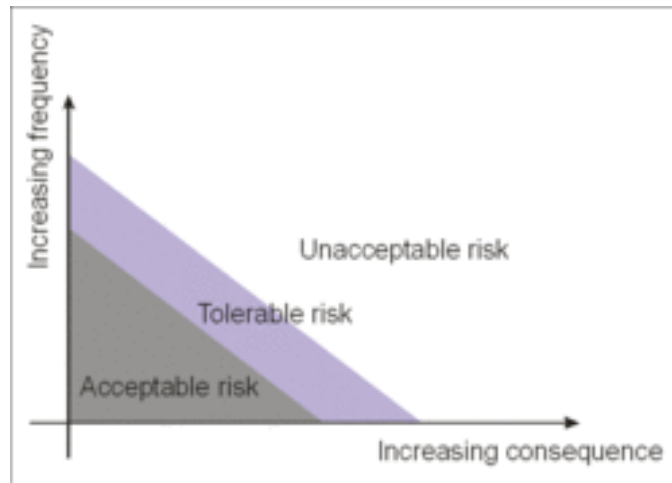
The major existing hazard in the watershed for causes of pathogenic events is the condition and location of the three (3) outhouses. The Work Plan in Section 3.0 contains action items for the outhouses, which are to be assessed in terms of how they can be engineered or relocated to reduce their risk.

The use of the Rainbow Trail is the next biggest concern for pathogenic contamination, only because as trail usage increases so does the chance of contamination of the water supply by humans or dogs. The Work Plan action items in Section 3.0 seek to minimize the risk posed by trail usage in the watershed utilizing various approaches including education, signage, monitoring and enforcement of permitted usage type.

The non-pathogenic Hazards in the watershed that pose a risk to source water quality are motorized vehicles. Motorized recreational/ commercial activity in the watershed is not permitted (with the exception of heli-skiing as detailed in Appendix C, Table 1, Hazard 1.16) and is not considered high risk. However if a motorized vehicle was to overturn in a creek, fuel could be carried to the intake, and from which there would be no treatment protection.

## 2.6 Thought Model for Discussing Acceptable Risk

The thought model that has been used to frame the discussion to date and will be referred to going forward is one of operating in a zone of “acceptable risk”. Figure 2.6.1 illustrates this concept.



**Figure 2.6.1: Defining Acceptable Risk**

While there are a number of other Hazards identified in the SWPP, the most complex component of the SWPP has been developing risk management strategies for recreation and its potential impacts to source water quality and this conversation has been used to illustrate how this thought model is applied.

When discussing the types of recreation to occur in the watershed the goal is to allow recreation, but to mitigate its impact such that the risk remains within the “acceptable risk to the health and water supply” zones. In terms of water supply, an increase in the frequency of turbidity events would eventually result in the consequence of no supply. In terms of health, an increase in the presence of pathogens would eventually result in the consequence of illness.

Based on this thought model RMOW’s intent is to strategically minimize the impact to source water quality from the expected growth of the trail use within, and from the trails immediately adjacent to, the watershed. The intent is to avoid the acceleration of trail usage within the watershed beyond the ability of MFLNRO and RMOW to manage the impact of an increased number of trail users on source water availability and quality. Discussion on how best to manage recreational use such that it does not have an adverse impact on raw source water quality will continue to be a focus of discussions by the TAC and the RMOW community.

At the time of Version 1 of the SWPP’s release it is recognized that there are some immediate concerns for source water quality resulting from recreational use of the watershed.

- Outhouses – See Hazard 1.14;
- Rainbow Trail condition, specifically the riparian zone of Rainbow Lake – See Hazard 1.11;

- Camping/campfires at Rainbow Lake – See Hazard 1.13a and 1.13b.

RMOW commits to developing plans (where more understanding for the present Hazard condition is needed), and taking action to implement the risk management strategies for these specific Hazards as a high priority as outlined in the Work Plan in Section 3.0.

### **3. WORK PLAN FOR ACTION ITEMS IN 2015/2016**

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A Work Plan of action items has been created for 2015 and 2016. By the end of 2016 a number of the actions in this Work Plan would have been completed or will be in progress and that will present an opportunity to prepare the Work Plan for 2017 and 2018.

The Work Plan describes a list of actions that RMOW commits to taking in 2015 and 2016. There are four categories for the types of actions that can be taken, assessment, documentation, construction and monitoring. These categories are provided only to give general sense of the type and phase of the work (assessment usually preceding some form of construction). The actions are grouped in terms of their ability to:

- Maintain and improve water availability and
- Maintain and improve water quality.

The actions are ordered according to approximate order of schedule throughout the year. Additional detail for each of the actions can be found in Table 1 in both Appendix B and C.

**Table 3.1: 2015 General Work Plan Actions for Twenty One Mile Creek Watershed**

Type	Task	Addresses Hazard #	Responsible	Type of Action
Presentation	Complete	All	<i>Joe Paul Michael Day</i>	Provide SWPP presentation to RMOW Council. Len Clarkson to attend.
Assessment	Complete	1.8 Intrinsic Climate Change	<i>Ted Battison</i>	RMOW is presently working on a climate change study called the Community Energy and Climate Adaptation Plan.
Assessment	Prepare RFP	1.12 Anthropogenic Outhouses	<i>Alistair McCrone Michael Day Dave Patterson</i>	Implement a formal Bio-waste Strategy for Twenty One Mile Creek Watershed with preliminary suggestions including: <ul style="list-style-type: none"> <li>• Install an outhouse below the water intake and indicate the preference for Day Hikers to use this facility;</li> <li>• Make a decision on whether to keep or abandon the middle outhouse;</li> <li>• Relocate the outhouse at Rainbow Lake to either outside the watershed or well away from water (at least 300m);</li> </ul> Investigate best technologies for any new and the existing outhouses in order to provide facilities that users will want to use. This may include retrofitting existing outhouses.
Presentation	Complete	1.11 Anthropogenic Trails/Trail Usage	<i>Dave Patterson to invite Michael Day</i>	RMOW Utilities Group member to attend the Trails Planning Working Group (TPWG) meetings where the Sproatt/Rainbow Trails are being discussed. TPWG to schedule a presentation from the RMOW UG for an overview of the SWPP to provide education for trail planning discussions. UG to periodically provide a refresher presentation as needed if the members of the TPWG change substantially.
Documentation	Complete	All	<i>Alistair McCrone Michael Day Martin Pardoe</i>	The mapping that is currently available for the watershed requires enhancement to show existing and proposed trails, roads, tenures, the watershed boundary, provincial and municipal jurisdictions and camping facilities.
Documentation	Complete	All	<i>Michael Day</i>	Include the actions completed from the SWPP and trail usage data in the annual Water Quality Report.
Documentation	Complete	1.17	<i>Michael Day</i>	Continue with execution of Annual Water

		Anthropogenic High User Demands		Conservation & Supply Plan
Documentation	Complete	All	<i>Michael Day</i>	Add quinquennial update of SWPP to Five year Capital Plan Water budget.
Documentation	Complete	All	<i>TAC Working Group</i>	Meet to review Work Plan for 2016 between September and October 15, 2015.

**Table 3.2: 2015 Work Plan actions that mitigate Hazards to source Water Availability**

Type	Task	Addresses Hazard #	Responsible	Type of Action
Assessment	Schedule onsite visit	1.2 Intrinsic Slope Failure	<i>Michael Day</i>	For Slumping Area 1 (Photo #18 in Assessment) Urban Systems to conduct site analysis and determine what slope remediation techniques are feasible.
Assessment	Schedule onsite visit	1.2 Intrinsic Slope Failure	<i>Michael Day</i>	For Slumping Area 2 (Photo #19 in Assessment), Urban Systems to conduct site analysis and determine what slope remediation techniques are feasible
Assessment	Schedule onsite visit	1.2 Intrinsic Slope Failure	<i>Michael Day</i>	For Slumping Area 3 (Photo #20 in Assessment), Urban Systems to conduct site analysis and determine what slope remediation techniques are feasible.

**Table 3.3: 2015 Work Plan actions that mitigate Hazards to source Water Quality**

Type	Task	Addresses Hazard #	Responsible	Type of Action
Construction	Complete	1.11 Anthropogenic Trails/Trail Usage	<i>Alistair McCrone Michael Day Martin Pardoe Jan Jansen Dave Patterson</i>	Update and add more signs (signage to provincial standard): <ul style="list-style-type: none"> <li>Update sign at entry to watershed above intake suggested text "You Are Entering a Drinking Water Watershed. Rainbow Lake Trail is for Day Use Hiking Only. Please Help Protect Whistler's Drinking Water Supply".</li> <li>Update signs at trail junctions that lead to the Watershed - suggested text "You Are Entering a Drinking Water Watershed. Rainbow Lake Trail is for Day Use Hiking Only. Please Help Protect Whistler's Drinking</li> </ul>

				<p>Water Supply”.</p> <ul style="list-style-type: none"> <li>• Add modular graphics based signs that reinforce approved trail use (hiking, taking pictures and picnic) include number of km to approved camping facilities.</li> <li>• Add modular graphics based signs indicating the trail usages that not permitted (swimming, campfires, dogs, bikes).</li> <li>• As part of the completion of the Trail remediation around Rainbow Lake, add a recommended number of educational signs.</li> </ul>
Monitoring	Complete	1.11 Anthropogenic Trails/Trail Usage	<i>RMOW Utilities Group Michael Day</i>	While discussions are in progress on how to best monitor trail use, RMOW to have staff hike into watershed once a month to observe usage, take photographs of trail, inspect outhouses, and look for evidence of campfires. The metrics to be collected are listed in Section 6.1. Frequency of watershed hike will increase as staff resources are available. Hike should take place on a Friday and/or weekend days.
Monitoring	Complete	1.11 Anthropogenic Trails/Trail Usage	<i>Dave Patterson</i>	Conduct ongoing maintenance and monitoring of present monitoring stations (counters) to ensure a data completeness and quality level that enables adequate trail use assessment. Data to be provided to Michael Day RMOW Utilities Group.

**Table 3.4: 2016 General Work Plan Actions for Twenty One Mile Creek Watershed**

Type	Task	Addresses Hazard #	Responsible	Description for Action
Assessment	Prepare Memo	1.8 Intrinsic Climate Change	<i>Michael Day</i>	Review the contents of the study specifically as they pertain to watershed management. Identify any gaps in the study.
Assessment	Update Annual Work Plan	All	<i>Michael Day</i>	Hike to Rainbow, Gin and Tonic Lakes to observe Rainbow Trail and riparian conditions at the Lakes.
Documentation	Complete	All	<i>Michael Day</i>	Include the actions completed from the SWPP and trail usage data in the annual Water Quality Report.
Documentation	Complete	1.17 Anthropogenic High User Demands	<i>Michael Day</i>	Continue with execution of Annual Water Conservation & Supply Plan
Documentation	Complete	All	<i>TAC Working Group</i>	Meet to review Work Plan for 2017 between September and October 15, 2016.

**Table 3.5: 2016 Work Plan actions that mitigate Hazards to source Water Availability**

Type	Task	Addresses Hazard #	Responsible	Description for Action
Assessment	Prepare RFP	1.1 Intrinsic Snowmelt and Rainfall	<i>Michael Day</i>	Feasibility study to determine if there is adequate access/ site suitability to install a turbidity monitoring station upstream of slumping area.
Assessment	PO to Consultant	1.7a and 1.7b Intrinsic Wildfire	<i>Heather Beresford</i>	Re-evaluate wildfire risk in 21 Mile watershed by applying a different weighting to 21 Mile Creek watershed and re-running model.
Monitoring	Prepare RFP	1.1 Intrinsic Snowmelt and Rainfall	<i>Michael Day</i>	Install turbidity monitoring station upstream of slumping areas pending outcome of feasibility study.
Construction	Prepare RFP	1.2 Intrinsic Slope Failure	<i>Michael Day</i>	For Slumping Area 1 (Photo #18 in Assessment) develop and execute a slope remediation plan.
Construction	Prepare RFP	1.2 Intrinsic Slope Failure	<i>Michael Day</i>	For Slumping Area 2 (Photo #19 in Assessment) develop and execute a slope remediation plan.
Construction	Prepare RFP	1.2 Intrinsic Slope Failure	<i>Michael Day</i>	For Slumping Area 3 (Photo #20 in Assessment) develop and execute a slope remediation plan.



**Table 3.6: 2016 Work Plan actions that mitigate Hazards to source Water Quality**

Type	Task	Addresses Hazard #	Responsible	Description for Action
Assessment & Monitoring	Complete	1.11 Anthropogenic Trails/Trail Usage	<i>Alistair McCrone Michael Day Dave Patterson</i>	Add monitoring stations (multi use counters) that enable adequate trail use assessment. Data to be provided to Michael Day. Add monitoring stations (multi use counters) that enable adequate trail use assessment. Data to be provided to Michael Day.
Assessment & Construction	Complete	1.14 Anthropogenic Outhouses	<i>Alistair McCrone Michael Day Len Clarkson</i>	RMOW to work with VCHA and MFLNRO regarding the Bio-waste Strategy. Submit recommendations to VCHA for review prior to any works taking place.
Assessment	Complete	1.9 Anthropogenic Roads	<i>Jeff Ertel</i>	Identify if there are any existing legal constraints for improvement or extension of the existing roadways.
Assessment	Complete	1.9 Anthropogenic Roads	<i>Michael Day</i>	Confirm whether future slumping control or fuel thinning activities will require improvement or extension of existing roads.
Assessment	Schedule a number of meetings to discuss	1.11 Anthropogenic Trails/Trail Usage	<i>McCrone Michael Day Jan Jansen</i>	RMOW to work with MFLNRO to establish a means of trail use monitoring and enforcement. Preliminary suggestions include: <ul style="list-style-type: none"> <li>• Boots on the ground</li> <li>• Surveillance (cameras)</li> </ul>

## **4. TWENTY-ONE MILE CREEK SOURCE WATER ASSESSMENT REFERENCE DOCUMENT**

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In January of 2015 Urban Systems completed the Twenty-One Mile Creek Source Water Assessment (“Assessment”). The purpose of the Assessment was to provide a summary of the formal Assessment process and findings, including the identified hazards, risks, and preliminary risk management concepts for reducing risks to water quality in the Twenty-One Mile Creek Watershed at the source level.

The Assessment is the foundation document on which the Twenty-One Mile Creek Source Water Protection Plan is based and for now (until components of that text are subsequently fully incorporated into this document) is referenced frequently and should be referred to for additional detail on certain subject matter. The following paragraphs are copied from Section 1 of the Assessment.

### **4.1 Purpose of Source Water Assessment**

“The Drinking Water Protection Act, established in BC in 2003, enables a Ministry of Health (MoH) drinking water officer to request a Source-to-Tap Assessment of drinking water supply systems across the province. These assessments are to be undertaken by the water supplier at the request of a drinking water officer. Surface water sources (lakes and streams) are open to the atmosphere, making these sources particularly vulnerable to contamination from anthropogenic activities and from natural sources in the watershed, such as: wildlife, landslides, fires or extreme runoff from heavy rain (BC Provincial Health Officer, 2001).

As a condition of RMOW’s drinking water operating permit issued by Vancouver Coastal Health, RMOW is required to develop this Source Protection Plan for the Twenty-One Mile Creek supply with reference to the MoH’s Comprehensive Source-to-Tap Assessment Guideline (2010), herein referred to as “the Guideline”. Therefore, RMOW initiated a water source assessment (herein referred to as “the assessment”) as defined under Part 3 of the Drinking Water Protection Act, so as to inform the development of the Source Protection Plan. As stated in the Drinking Water Protection Act, the intent of the assessment was to:

- identify and evaluate the hazards to drinking water quality and quantity;
- characterize the risks; and

- propose risk management strategies.”<sup>9</sup>

“Twenty-One Mile Creek watershed was assessed in the late summer of 2014 according to selected modules of the Guideline, as discussed in Section 2.”<sup>10</sup>

#### **4.2 Overview of RMOW’s Drinking Water Source**

“Community watersheds in the province of British Columbia (BC) supply many local communities with their drinking water. These watersheds also have a variety of other uses including: forestry, mining, agriculture, urban development, and recreation, and are known as multi-use watersheds (BC Provincial Health Officer, 2001).

For the Resort Municipality of Whistler (RMOW), the primary source of drinking water is Twenty-One Mile Creek (which is supplemented by groundwater). RMOW has used Twenty-One Mile Creek as a drinking water source since 1985. In addition to providing the community with drinking water, the Twenty-One Mile Creek watershed is an important recreational resource in the area and multiple organizations are seeking to expand access to, and recreation within, this multi-use watershed.”<sup>11</sup>

An overview of the disinfection system for Twenty-One Mile Creek is summarized in Section 5.5 of the Assessment.

#### **4.3 Drinking Water Source Protection**

The key to ensuring clean, safe, and secure drinking water is to implement multiple barriers throughout the drinking water system. The multi-barrier approach aims to reduce the risk of drinking water contamination, and to increase the feasibility and effectiveness of remedial controls or preventative options (Canadian Council of Ministers of the Environment (CCME), 2004). [Edit Michael Day] In plain language, for Whistler, this means keeping the source water clean so Whistler’s disinfection systems can do their job. Source water protection is an important component of the multi- barrier approach to ensuring safe drinking water. The Action Plan for Safe Drinking Water in BC recognizes “source protection as a critical part of drinking water protection.”

#### **4.4 Hazard and Risk**

“As this assessment ultimately focuses on risks to drinking water quality and quantity, and concludes with preliminary risk management strategies, it is important to differentiate hazard from risk:

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<sup>9</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 1.3.

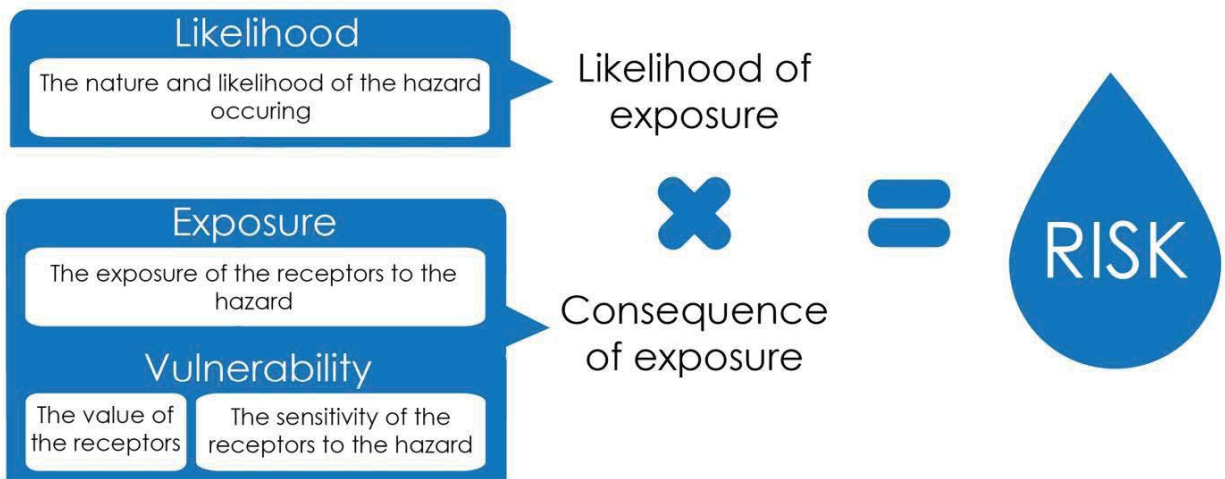
<sup>10</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 1.3

<sup>11</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 1.1

Hazard: “a source of potential harm to the functioning of any aspect of the drinking water system or to human health” (Canadian Council of Ministers of the Environment, 2004).

Risk: the product of the likelihood of a hazard occurring and the potential consequences to elements at risk (the receptor). Risk is a function of likelihood, exposure, the value of the receptor, and the sensitivity of the receptor to the hazard, as illustrated below.

For this assessment, a hazard can be considered the source of potential physical, biological or chemical contaminants or threats, which present risks to Twenty-One Mile Creek (the receptor) at the intake based on their potential consequences to this source”<sup>12</sup>.



<sup>12</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 1.4.

## 5. SUMMARY OF HAZARDS TO DRINKING WATER QUALITY AND QUANTITY

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A summary of hazards to drinking water quality and quantity were outlined in Twenty-One Mile Creek Source Water Assessment prepared for the RMOW by Urban Systems in Section 4.5 of the Assessment. The following paragraph is an excerpt from that Section.

“Based on the literature review of available resources and the findings of the field investigation, existing and potential source hazards (and associated contaminants of concern) were identified. Intrinsic hazards were identified in Module 1, and anthropogenic hazards were identified in Module 2 during the contaminant source inventory.

The Hazard Identification Summary in (Table 4.3) provides the following:

- Types of hazards within the assessment area;
- Physical, biological and chemical contaminants associated with the hazards;
- Potential effects of hazards at the source level;
- Measures in place to prevent introduction of contaminants to the source water; and
- Existing preventative measures and associated barriers at the source level.”<sup>13</sup>

The hazards have each been given a Risk Rating that represents a product of the Consequence of Risk and Likelihood of Risk.

The scoring of these components is described in Sections 6.5, 6.6 and 6.7 of the Assessment.

It is important to note that the Risk Ratings are merely relative for the Hazards present in the watershed. While the Risk Ratings do not provide any means of quantitatively determining the risk to the health of the population, there are quantitative measures that are critical to informing the qualitative analysis.

### 5.1 Quantitative Measures

The proposed list of quantitative measures is outlined below. How the metrics are to be collected is also provided.

Hazard #	Hazard Description	Metric	How is Metric Collected
1.1	Snowmelt and rainfall	Take photo	Hike Survey (See Appendix E. &

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<sup>13</sup> Twenty-One Mile Creek Source Water Assessment RMOW, Urban Systems 2015 See Section 4.5.

			Work Plan 2015/2016)
1.2	Slope Failure	To be developed as part of slope stabilization projects.	See Table 1 Appendix B.
1.3	Debris Flood	Take photo if observed	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.4	Rockfall	Take photo if observed	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.5	Wildlife	Count all	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.6	Mountain Pine Beetle	Take photo if observed	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.7	Wildfire	Overall monitoring and Annual Status update	
1.8	Climate Change	Metric not established	
1.9	Roads	Metric not established	
1.10	Forestry	Overall monitoring and Annual Status update	
1.11	Non-motorized Trail Use (NMTU)	Count hikers (include observers)	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.11	NMTU	Trail Count	Trail Counters (See Table 3.3 Section 3.0.)
1.11	NMTU	Count MTB	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.11	NMTU	Take photo(s) of any trail erosion	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.12	Domestic Pets	Count Dogs	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.13a/b	Campfire/Camping	Count/ Take photo	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.14	Outhouses	Inspect from bottom to top	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.15	Snowmobiling	Count (remains of)	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.16	Heli-skiing	Count (summer fly overs)	Hike Survey (See Section 3.0 Table 3.3 & Appendix E.)
1.17	High User Demands	Percentage Maximum Day Demand can that be provided by sources other than 21-Mile Creek.	RMOW Water Conservation & Supply Plan

An example of a template for collecting the “Hike Survey” field observations is attached in Appendix E.

## **5.2 Strategies to Address Intrinsic (Natural) Risks**

The intrinsic risks to the watershed are summarized in Table 1 Appendix B. This table also summarizes the risk management strategies, proposed schedule and cost to address the intrinsic risks.

## **5.3 Strategies to Address Anthropogenic (Land Use and Human Activity) Risks**

The anthropogenic risks to the watershed are summarized in Table 1 Appendix C. This table also summarizes the risk management strategies, proposed schedule and cost to address the anthropogenic risks.

## **6. ROLE OF THE TECHNICAL ADVISORY COMMITTEE, (TAC)**

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### **6.1 Participating Organizations**

The TAC Executive Subcommittee and Working Group for the Twenty-One Mile Creek SWPP shall have, at minimum, representation from the following organizations:

- Resort Municipality of Whistler (RMOW);
- Ministry of Forest Lands & Natural Resources Operations (MFLNRO);
- Vancouver Coastal Health Authority (VCHA).

### **6.2 TAC Executive Subcommittee**

For the TAC Executive Subcommittee representative positions from within the organizations listed in 6.1, and current (2015) holders of those positions are indicated:

#### **RMOW**

- Jan Jansen – General Manager Resort Experience - [jjansen@whistler.ca](mailto:jjansen@whistler.ca)
- Joe Paul – General Manager Infrastructure Services– [jpaul@whistler.ca](mailto:jpaul@whistler.ca)

#### **MFLNRO**

- Alistair McCrone - Recreation Officer - [alistair.mccrone@gov.bc.ca](mailto:alistair.mccrone@gov.bc.ca)

#### **VCHA**

- Len Clarkson - Water Specialist and Drinking Water Officer - [len.clarkson@vch.ca](mailto:len.clarkson@vch.ca)

The TAC Executive Subcommittee shall review and approve recommendations from the TAC Working Group on an as needed basis. Decision making at the Executive Subcommittee level shall result from consensus. TAC Executive Subcommittee meeting minutes shall be recorded.

### **6.3 TAC Working Group**

For the TAC Working Group representative positions from within the organizations listed in 6.1, and current (2015) holders of those positions are indicated:

#### **RMOW**

- Michael Day - Utilities Group Manager - [mday@whistler.ca](mailto:mday@whistler.ca)



- Martin Pardoe – Manager Resort Parks Planning – [mpardoe@whistler.ca](mailto:mpardoe@whistler.ca)
- Heather Beresford - Manager Environmental Stewardship - [hberesford@whistler.ca](mailto:hberesford@whistler.ca)
- Dave Patterson – Manager of Resort Operations - [dpatterson@whistler.ca](mailto:dpatterson@whistler.ca)

The TAC Working Group shall convene to review metrics and Work Plan action times, establish future Work Plan action items and in general manage the active components of the SWPP. TAC Working Group meeting minutes shall be recorded. Decision making at the Working Group Subcommittee level shall result from consensus. If consensus cannot be reached a recommendation with dissenting options shall be documented and be provided to the Executive Subcommittee for review and approval.

## **7. PERIODIC REVIEW OF THE SOURCE WATER PROTECTION PLAN**

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### **7.1 SWPP Review and Revision**

It is intended that this Plan be reviewed and revised to adequately manage the risks that will result from changing conditions (increases or decreases in the trends or impacts of new and existing Hazards) within and immediately adjacent to the watershed. Throughout the 2015-2016 periods, following adoption of the SWPP by RMOW Council, review and updates are to be on-going.

The SWPP risk management strategies, hazard assessments and Work Plan are intended to be reviewed annually, at minimum, by the TAC Working Group. The risk management strategies may also be reviewed at any time, by a member of the TAC Working Group convening a meeting to discuss specific Hazards. Once every five (5) years a major review of the SWPP shall be conducted.

The Work Plan in Section 3.0 lists those activities that RMOW will complete in 2015 and 2016 and on an annual basis for the foreseeable future namely:

- Hike to Rainbow, Gin and Tonic Lakes to observe Rainbow Trail and riparian conditions at the Lakes in the month of September preceding the annual TAC meeting. Executive and TAC Working Group members to be invited.
- Conduct ongoing maintenance and monitoring of present monitoring stations (counters) to ensure data completeness and a quality level that enables adequate trail use assessment.
- Include the actions completed from the SWPP and trail usage data in the annual Water Quality Report.
- Update all quantitative measures listed in Section 6.1 and adjust qualitative hazard assessments and annual Work Plan as needed.

RMOW also commits to the following every five (5) years:

- Comprehensive review of the SWPP, hazard assessments and condition of the watershed coordinated by an external consultant to assess the metrics collected per Section 6.1. Cost estimated at \$25,000.

### **7.2 SWPP Annual Work Plan**

The consultation, reviews and approvals needed to update the SWPP annual Work Plan for will include the following steps:

1. A TAC Working Group meeting attended by all members;
2. Review and approval of Work Plan by TAC members;
3. Completion of a Section 57 application to MFLNRO as needed per that process;
4. Review and approval of Work Plan by TAC Executive Subcommittee.

### **7.3 SWPP Revisions**

The consultation, reviews and approvals needed to revise the SWPP will include the following steps:

1. A TAC Working Group meeting attended by all members;
2. Review and approval of SWPP Revision by TAC Working Group members;
3. Completion of a Section 57 application to MFLNRO as needed per that process;
4. Review and approval of SWPP Revision by TAC Executive Subcommittee;
5. Review and approval of SWPP Revision by RMOW Council.

**8. Appendix A. Watershed Maps**



**Legend - Trail Features**

- Trail Segment Number
- Trail Linker
- Flighting Year
- 2013
- 2014

**Trail Work Type - Construction Year**

- Revised/Abandon - 2012
- New - 2012
- Revised/Abandon - 2014
- New - 2014
- Revised/Abandon - 2015
- New - 2015
- Revised/Abandon - 2016
- New - 2016

**Existing Trails**

- Public Trail 90%
- Quasi-Trail Access
- Openlink
- Valley Trail

**Legend - Other Features**

- BC OIA - Boundary
- Chickamauc Community - Local
- Chickamauc Management #4 (a) (1.5g)
- Urbicula Winter Range
- Grizzly Bear Habitat Area
- BC OIA Watershed Reserve
- Carleton Place Wilderness Adventures - Existing Tenure
- Carleton Place Wilderness Adventures - Proposed Tenure
- Oblique Olympic Park - Existing Tenure
- Road - Paved
- Road - Gravel
- Railway - Single Track
- Transmission Line
- Sidg
- Carleton Place Wilderness Adventures - Existing Trail
- Carleton Place Wilderness Adventures - New Route
- Carleton Place Wilderness Adventures - Proposed Trail
- Doubletrack/Resource Road
- Corridor - 100m Interval
- Watercourse

Trails Planning Working Group  
 Sproat/Rainbow Trail Network Concept Plan  
 Whistler, BC

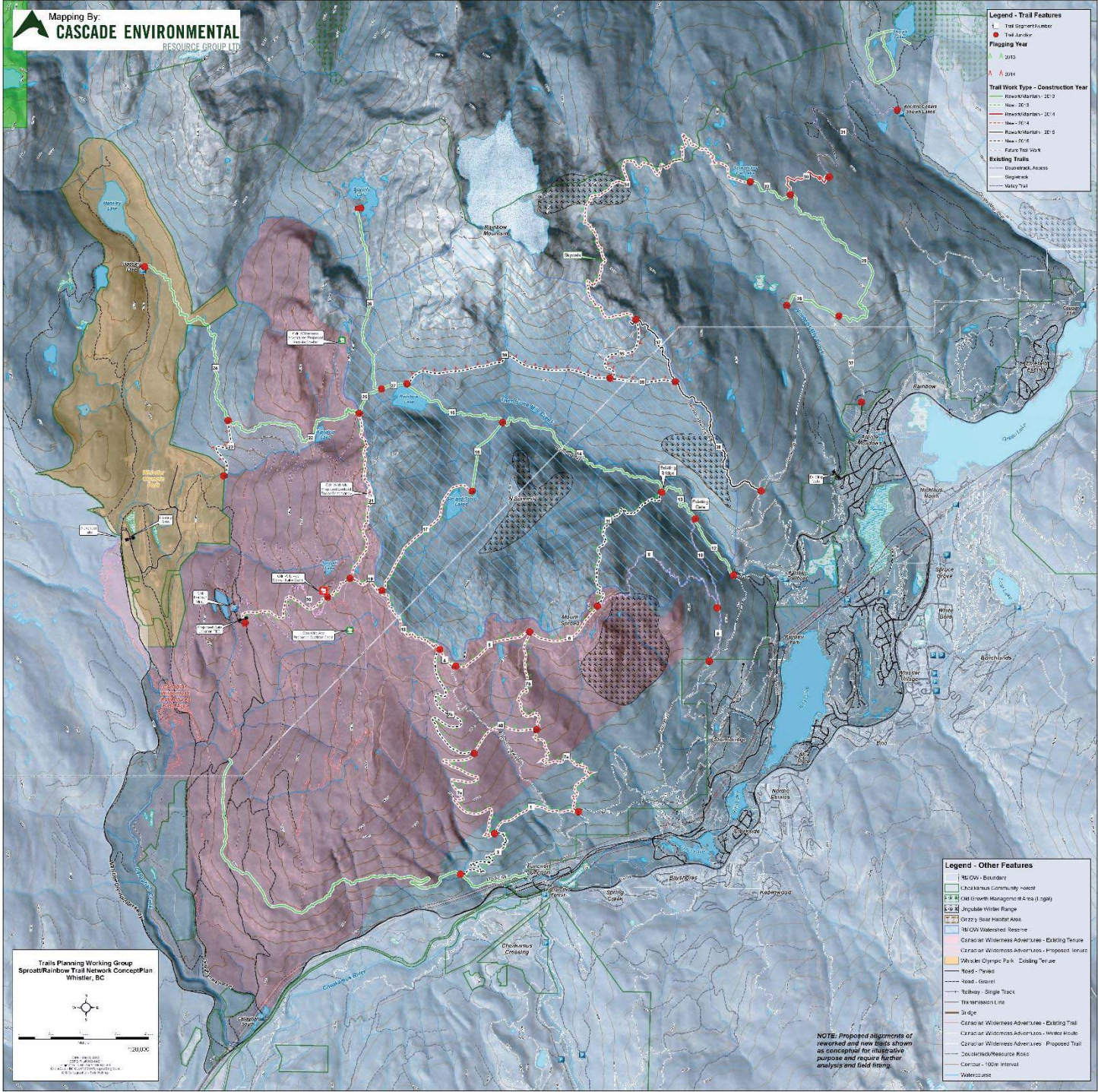
SCALE: 1:50,000

DATE: 2014-10-14

PROJECT: SPROAT/RAINBOW TRAIL NETWORK CONCEPT PLAN

CLIENT: WHISTLER COMMUNITY DEVELOPMENT

**NOTE:** Proposed alignments of revised and new bits shown as conceptual for illustrative purpose and require further analysis and field trip.



**9. Appendix B. Detail Pertaining to Intrinsic Risks**



**Table 1: Risk management strategies to address intrinsic risks.**

Hazard 1.1		Risk – Very High	Consequence - 3	Likelihood - A
Snowmelt and rainfall (peak flows)]  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration	<i>Comments:</i> <ul style="list-style-type: none"> <li>The risk to water quality will increase as natural sediment loads increase with increasing peak flows. See Hazard 1.8.</li> </ul> <i>Risk Management Strategy:</i> Monitor the turbidity of the water upstream of the slumping areas to observe water quality trends over time.			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	Feasibility study to determine if there is adequate access/ site suitability to install a turbidity monitoring station upstream of slumping area.	RMOW Utilities Group <i>Michael Day</i>	Prepare RFP for services to be tendered in 2016.	\$5,000
	Install turbidity monitoring station upstream of slumping areas pending outcome of feasibility study.	RMOW Utilities Group <i>Michael Day</i>	Prepare RFP for services to be tendered in 2016. Installation to occur in 2017.	\$15,000 - \$100,000
Hazard 1.2		Risk – High	Consequence - 3	Likelihood - C
Slope Failure  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration	<i>Comments:</i> <ul style="list-style-type: none"> <li>The risk to water quality from slope failures will continue to increase with increasing peak flows, see Hazards 1.1 and 1.8.</li> </ul> <i>Risk Management Strategy:</i> Investigate how slopes can be engineered to improve stability.			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>

	For Slumping Area 1 (Photo #18 in Assessment) Urban Systems to conduct site analysis and determine what slope remediation techniques are feasible.	RMOW Utilities Group <i>Michael Day</i>	September 2015	\$2,500 (in conjunction with other slumping areas)
	For Slumping Area 1 (Photo #18 in Assessment) develop and execute a slope remediation plan.	RMOW Utilities Group <i>Michael Day</i>	Prepare RFP for services to be tendered and constructed at a date TBD.	\$100,000
	For Slumping Area 2 (Photo #19 in Assessment), Urban Systems to conduct site analysis and determine what slope remediation techniques are feasible	RMOW Utilities Group <i>Michael Day</i>	September 2015	\$2,500 (in conjunction with other slumping areas)
	For Slumping Area 2 (Photo #19 in Assessment) develop and execute a slope remediation plan.	RMOW Utilities Group <i>Michael Day</i>	Prepare RFP for services to be tendered and constructed at a date TBD.	\$100,000
	For Slumping Area 3 (Photo #20 in Assessment), Urban Systems to conduct site analysis and determine what slope remediation techniques are feasible.	RMOW Utilities Group <i>Michael Day</i>	September 2015	\$2,500 (in conjunction with other slumping areas)
	For Slumping Area 3 (Photo #20 in Assessment) develop and execute a slope remediation plan.	RMOW Utilities Group <i>Michael Day</i>	Prepare RFP for services to be tendered and constructed at a date TBD.	\$100,000



Hazard 1.3	t	Risk – High	Consequence - 4	Likelihood - E
Debris Flood  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration	<i>Comments:</i> <ul style="list-style-type: none"> <li>Debris flows are related to Hazard 1.1, 1.2 and 1.8.</li> </ul>			
	<i>Risk Management Strategy:</i> See RMS for Hazards 1.1, 1.2 and 1.8.			
	Specific Action Items	Responsible	Proposed Schedule	Estimated Cost
None at this time.				
Hazard 1.4		Risk – Low	Consequence - 1	Likelihood - E
Rock fall  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration	<i>Comments:</i> A rock fall is unlikely to impact water quality for a long period should it occur.			
	<i>Risk Management Strategy:</i> None at this time.			
	Specific Action Items	Responsible	Proposed Schedule	Estimated Cost
None at this time.				
Hazard 1.5		Risk – Very High	Consequence - 3	Likelihood - A
Wildlife  <b>Contaminant(s)</b> Bacteria Protozoa	<i>Comments:</i> <ul style="list-style-type: none"> <li>The risk to water quality from wildlife is exceptionally difficult to mitigate in this watershed. Increased recreational demands in the watershed may result in a reduction in wildlife population with corresponding pathogen load reduction.</li> <li>See Section 3.2.7 of Assessment for further background.</li> </ul>			
	<i>Risk Management Strategy:</i> None at this time.			
	Specific Action Items	Responsible	Proposed	Estimated Cost
None at this time.				

			Schedule	
	None at this time.			
<b>Hazard 1.6</b>		<b>Risk – Low</b>	<b>Consequence - 1</b>	<b>Likelihood - E</b>
Mountain Pine Beetle (MPB)  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>The MPB was present in Twenty-One Mile Creek watershed however the extent of mature lodge pole pine leading stands are limited to an area in the mid-to-lower elevations of the watershed (iMapBC 2.0). Overall the beetle has had a negligible impact on the visual quality and hydrology of the watershed.</li> <li>As the climate changes, the risks of other invasive species may increase and have an impact on the forest health.</li> <li>See Section 3.2.9 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i> See Hazard 1.17.</p>			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	None at this time.			
<b>Hazard 1.7a</b>		<b>Risk – Low</b>	<b>Consequence - 1</b>	<b>Likelihood - C</b>
Small Wildfire  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration, organic content	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>The risk to water quality from a small wildfire is considered to be low.</li> <li>Fuel thinning activities have been outcomes of the recent wildfire studies which include the 21 Mile Creek watershed in the study area.</li> <li>See Section 3.2.10 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i> Follow recommendations from Wildfire Studies.</p>			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>

	Re-evaluate wildfire risk in 21 Mile watershed by applying a different weighting to 21 Mile Creek watershed and re-running model.	RMOW Resort Experience <i>Heather Beresford</i>	2016	Internal
<b>Hazard 1.7b</b>		<b>Risk – Very High</b>	<b>Consequence - 5</b>	<b>Likelihood - C</b>
Catastrophic Wildfire  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration, organic content	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>The risk to water quality/availability from wildfire is considered to be low, but if a catastrophic wildfire occurred in the watershed this risk increases to very high</li> <li>Both the RMOW Community Wildfire Protection Plan and the landscape level plan identify the critical infrastructure in the watershed. However the 21 Mile Creek watershed but did not receive a higher weighting in the model due to its status as a municipal water supply source.</li> <li>See Section 3.2.10 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i> It is not necessarily possible to prevent a catastrophic wildfire from occurring. Manage the areas around the critical infrastructure such that if a catastrophic wildfire were to occur those assets would be less likely to be affected. Also see RMS for Hazard 1.18</p>			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	Run the model and apply a different weighting to the consequences of a fire in 21 Mile watershed.	RMOW Resort Experience <i>Heather Beresford</i>	2016	
	Prepare a wildfire management plan for the 21 Mile watershed which may include fuel thinning.	RMOW Resort Experience <i>Heather Beresford</i>	2017	Internal \$20,000-\$30,000
<b>Hazard 1.8</b>		<b>Risk – Moderate</b>	<b>Consequence - 2</b>	<b>Likelihood - C</b>
Climate Change	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>If there is an increased variability in annual snowpack or there is a long-term decline in annual</li> </ul>			

<p><b>Contaminant(s)</b> Impacts to water quantity, quality, wildfire risk</p>	<p>average snowpack there may be reduced runoff; but due to the present robust supply the risk to water quantity is moderate. In the near future, 10 years, there may be a shift in peak flow timing and quantity per Hazard 1.1.</p> <p><i>Risk Management Strategy:</i> Conduct a climate change study so that RMOW is in a state of preparedness with respect to any potential short and long term impact on water supply from Twenty-One Mile Creek Watershed.</p>			
	<p><b>Specific Action Items</b></p>	<p><b>Responsible</b></p>	<p><b>Proposed Schedule</b></p>	<p><b>Estimated Cost</b></p>
<p>RMOW is presently working on a climate change study called the Community Energy and Climate Adaptation Plan.</p>	<p>RMOW CAO Office <i>Ted Battiston</i></p>	<p>End of 2015</p>	<p>Internal</p>	
<p>Review the contents of the study specifically as they pertain to watershed management. Identify any gaps in the study.</p>	<p>RMOW Utilities Group <i>Michael Day</i></p>	<p>January 2016</p>	<p>Internal</p>	

**10. Appendix C. Detail Pertaining to Anthropogenic Risks**

**Table 1: Risk management strategies to address anthropogenic risks.**

Hazard 1.9		Risk – Low	Consequence - 1	Likelihood - E
Roads  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>It is assumed that there will always be some sediment transport from overland flow and potential slumping from existing roads.</li> <li>See Section 4.3.1 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i>            Control and limit any additional access road construction with a goal of no additional construction.</p>			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	Identify if there are any existing legal constraints for improvement or extension of the existing roadways.	RMOW Development Services <i>Jeff Ertel</i>	January 2016	Internal
	Confirm whether future slumping control or fuel thinning activities will require improvement or extension of existing roads.	RMOW Utilities Group <i>Michael Day</i>	January 2016	Internal
Hazard 1.10		Risk – Low	Consequence - 1	Likelihood - E
Forestry  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration, herbicide	<p><i>Comments:</i></p> <p>There is no planned forestry in the future (excepting activities captured under Hazard 1.7), so this risk to water quality will remain low. See Section 4.3.2 of Assessment for further background.</p> <p><i>Risk Management Strategy:</i></p> <p>None at this time. The Whistler Community forest has publically committed to not logging in this watershed.</p>			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	None at this time.			

Hazard 1.11		Risk – Low	Consequence - 2	Likelihood - D
<b>Trails/ Non-motorized Trail Use</b>  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration Bacteria Protozoa	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>The risk to water quality from recreational trail use will increase as use of the primary trail (Rainbow Trail) increases, and as approved trail development outside the watershed boundary continues with resulting increased demand from recreationalists.</li> <li>The intent is to strategically manage the impact as use of the trail grows. The intent to avoid acceleration of trail usage within the watershed beyond the ability of MFLNRO and RMOW to manage the impact of an increased number of trail users on source water quality.</li> <li>See Section 4.3.3 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i></p> <ul style="list-style-type: none"> <li>Maintain existing trail use type within the watershed (hiking).</li> <li>Increase signage and education with respect to watershed stewardship with trail users through local clubs (for example ACC, WORCA).</li> <li>Due to the apparent level of highly inappropriate trail use at Rainbow Lake (examples swimming, camping, campfire) RMOW to consult with MFLNRO on how to best implement monitoring and enforcement of trail usage in order to manage the impact from trails adjacent to the watershed, specifically those trails that ease access to the watershed.</li> <li>Additional monitoring data for frequency and user type is to be collected to better understand the number and type of users on trails in and adjacent to the watershed and in order to review usage trends in the future.</li> <li>Develop the trail network as detailed under the approval granted for the Section 57 application to MFLNRO - Recreation Sites and Trails BC Authorization Letter June 3, 2014.</li> <li>Any additional trail building for trails in or adjacent to the Watershed to occur under the approval process provided in Section 7.0.</li> </ul>			
<i>General Approach</i>	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	Provide SWPP presentation to Council. Len Clarkson to be in attendance.	RMOW Utilities Group	2015	

		<i>Michael Day</i> RMOW Infrastructure Services <i>Joe Paul</i> VCHA <i>Len Clarkson</i>		
	RMOW Utilities Group member to attend the Trails Planning Working Group (TPWG) meetings where the Sproatt/Rainbow Trails are being discussed. TPWG to schedule a presentation from the RMOW Utilities Group regarding source water quality guidelines to provide education for future trail planning discussions.	RMOW Parks Operations <i>Dave Patterson</i> To invite RMOW Utilities Group <i>Michael Day</i>	Next meeting in 2015	
	The mapping that is currently available for the watershed requires enhancement to show existing and proposed trails, roads, tenures, the watershed boundary, provincial and municipal jurisdictions and camping facilities.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Planning <i>Martin Pardoe</i>	Fall 2015	
	For the Trails being developed the trail network as detailed in the under the approval granted for the Section 57 application to MFLNRO - Recreation Sites and Trails BC Authorization Letter June 3, 2014 SWPP TAC to assist with the development of the Trail Management Objectives for submission to MFLNRO.	RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>	2016	



<p><i>Rainbow Trail and trails within 21 Mile Creek Watershed Sproatt/Rainbow Trails (specifically trails adjacent to watershed)</i></p>	<p>Various websites have conflicting information about Rainbow Trail usage, and some do not mention that the Rainbow Trail or Rainbow Lake is in a watershed. Suggestion is to have summer student research web material and work with website owners to update material.</p>	<p>RMOW Utilities Group <i>Michael Day</i></p>	<p>Summer 2017</p>	
	<p>Include the actions completed from the SWPP and trail usage data in the annual Water Quality Report.</p>	<p>RMOW Utilities Group <i>Michael Day</i></p>	<p>Annually</p>	
	<p>Consider new multi-use (biking/hiking) trails in the future if it is within the ability of MFLNRO and RMOW to manage the impacts on source water quality. Any additional trails proposed to be built would occur under the approval process provided in Section 7.0. (130509_SproattTrailPlan_AllYears_Rev6).</p>	<p>RMOW UG <i>Michael Day</i> RMOW Resort Experience <i>Jan Jansen</i></p>	<p>TBD</p>	
	<p><b>Specific Action Items</b></p>	<p><b>Responsible</b></p>	<p><b>Proposed Schedule</b></p>	<p><b>Estimated Cost</b></p>
	<p>Update and add more signs (signage to provincial standard):</p> <ul style="list-style-type: none"> <li>Update sign at entry to watershed above intake suggested text -“You Are Entering a Drinking Water Watershed. Rainbow Lake Trail is for Day Use Hiking Only. Please Help Protect Whistler’s Drinking Water Supply”.</li> <li>Update signs at trail junctions that lead to the Watershed - suggested text “You Are Entering a Drinking Water Watershed. Rainbow Lake Trail is for Day</li> </ul>	<p>MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i> RMOW Parks Planning <i>Martin Pardoe</i></p>	<p>Immediately</p>	

	<p>Use Hiking Only. Please Help Protect Whistler's Drinking Water Supply".</p> <ul style="list-style-type: none"> <li>• Add modular graphics based signs that reinforce approved trail use (hiking, taking pictures and picnic) include number of km to approved camping facilities.</li> <li>• Add modular graphics based signs indicating the trail usages that not permitted (swimming, campfires, dogs, bikes).</li> <li>• As part of the completion of the Trail remediation around Rainbow Lake, add a recommended number of educational signs.</li> </ul>			
	<p>Conduct ongoing maintenance and monitoring of present monitoring stations (counters) to ensure a data completeness and quality level that enables adequate trail use assessment. Data to be provided to Michael Day RMOW Utilities Group.</p>	<p>RMOW Parks Operations <i>Dave Patterson</i></p>	<p>Ongoing</p>	
	<p>While discussions are in progress on how to best monitor trail use, RMOW to have staff hike into watershed once a month to observe usage, take photographs of trail, inspect outhouses, and look for evidence of campfires. Frequency of watershed hike will increase as staff resources are available. Hike should take place on a Friday and/or weekend days.</p>	<p>RMOW Utilities Group <i>Michael Day</i></p>	<p>2015</p>	
	<p>RMOW to work with MFLNRO to establish a means of trail use monitoring and</p>	<p>MFLNRO <i>Alistair McCrone</i></p>	<p>2016</p>	

<i>Rainbow Trail at Rainbow Lake Riparian Zones at Rainbow, Gin, and Tonic Lakes</i>	enforcement. Preliminary suggestions include: <ul style="list-style-type: none"> <li>Boots on the ground</li> <li>Surveillance (cameras)</li> </ul>	RMOW Utilities Group <i>Michael Day</i> RMOW Resort Experience Jan Jansen		
	Add monitoring stations (multi use counters) that enable adequate trail use assessment. Data to be provided to Michael Day RMOW Utilities Group.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>	Spring 2016	
	Add barriers to prevent trail users from accessing the water at the three (3) bridge crossings.	MFLNRO <i>Alistair McCrone</i>	2017	
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	RMOW to conduct site analysis and execute a Rainbow Lake Riparian Zone Remediation Plan. RMOW to determine what trail remediation techniques are feasible with the preliminary suggestion of moving the trail away from the riparian zone and installing a boardwalk with ropes to create a visual barrier.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>	2015/2016/2017	
	Hike to Rainbow, Gin and Tonic Lakes to observe Rainbow Trail and riparian conditions at the Lakes.	RMOW Utilities Group <i>Michael Day</i> RMOW Parks	Annually, starting Spring 2016	

		Operations <i>Dave Patterson</i> MFLNRO <i>Alistair McCrone</i>		
<b>Hazard 1.12</b>		<b>Risk – Low</b>	<b>Consequence - 1</b>	<b>Likelihood - E</b>
Domestic Animals (specifically dogs but also horses)  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration Bacteria Protozoa	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>Domestic animals are not permitted entry to the watershed. The risk to water quality from domestic animals will only increase due to the use of the primary trail (Rainbow Trail) increasing and as trail development just outside the watershed boundary continues and due to increased demand from recreationalists.</li> <li>The intent is to strategically manage the impact from the organic growth of trail use. The intent is to avoid acceleration of trail usage within the watershed beyond the ability of MFLNRO and RMOW to manage the impact of increased usage on source water quality.</li> <li>See Section 4.3.3 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i></p> <ul style="list-style-type: none"> <li>Horse and pack animals are not permitted within the Twenty-One Mile Creek Valley<sup>14</sup></li> <li>Maintain existing trail use in the watershed to the existing user type (hiking, no dogs)</li> <li>Additional monitoring data for frequency and non-approved user type is to be collected to better understand the number and type of user in the watershed and in order to review usage trends.</li> <li>RMOW to increase signage and education.</li> <li>RMOW to consult with MFLNRO on how to best implement monitoring and enforcement of trail usage.</li> </ul>			
	<b>Specific Action Items</b>	<b>Responsible</b>	<b>Proposed Schedule</b>	<b>Estimated Cost</b>
	Per Hazard 1.11 add additional signs on Rainbow Trail reinforcing approved trail usage.	<i>Alistair McCrone</i> <i>RMOW Utilities Group</i>	Immediately	

<sup>14</sup> Sea to Sky Land and Resource Management Plan April 2008

		<i>Michael Day</i> <i>RMOW Parks</i> <i>Operations</i> <i>Dave Patterson</i> <i>RMOW Parks</i> <i>Planning</i> <i>Martin Pardoe</i>		
	Add monitoring stations (multi use counters) that enable adequate trail use assessment. Data to be provided to Michael Day RMOW UG.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>	September 2016 for plan completion. May 2017 for additional counter implementation.	
	RMOW to work with MFLNRO to establish a means of trail use monitoring and enforcement.	<i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i>		
<b>Hazard 1.13a</b>		<b>Risk –High</b>	<b>Consequence - 3</b>	<b>Likelihood - C</b>
Campfire  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration Total organic compound	<i>Comments:</i> <ul style="list-style-type: none"> <li>• Despite prohibition of campfires in the watershed, three (3) extinguished, well-constructed, campfires were found at Rainbow Lake on June 12, 2015.</li> <li>• The risk of campfires increases if there are more recreationalists without alternate approved campsite choices.</li> <li>• The risk to water quality from campfire use is its potential to result in Hazard 1.7a and 1.7b.</li> <li>• See Section 4.3.3 of Assessment for further background.</li> </ul> <i>Risk Management Strategy:</i>			

	<ul style="list-style-type: none"> <li>• MFLNRO encouraging camping at Hanging Lake through improved facilities.</li> <li>• Overnight camping is discouraged, except for emergency purposes. New formal campsites will not be developed and signage will be used to inform hikers of appropriate camping locations outside of the watershed. Existing camping areas along the Rainbow-Madeley trail will be retained and may be improved to reduce environmental impact from campers. Future recreational development will focus on minimizing the potential for water contamination, such as upgraded toilet facilities, trail maintenance to reduce erosion, and public outreach on appropriate sanitary practices.<sup>15</sup></li> <li>• RMOW to consult with MFLNRO on how to best implement monitoring and enforcement of campfire prohibition.</li> </ul>								
	<table border="1"> <thead> <tr> <th>Specific Action Items</th> <th>Responsible</th> <th>Proposed Schedule</th> <th>Estimated Cost</th> </tr> </thead> <tbody> <tr> <td>Per Hazard 1.11 RMOW to work with MFLNRO to establish a means of trail use monitoring and enforcement.</td> <td>MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i></td> <td></td> <td></td> </tr> </tbody> </table>	Specific Action Items	Responsible	Proposed Schedule	Estimated Cost	Per Hazard 1.11 RMOW to work with MFLNRO to establish a means of trail use monitoring and enforcement.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>		
Specific Action Items	Responsible	Proposed Schedule	Estimated Cost						
Per Hazard 1.11 RMOW to work with MFLNRO to establish a means of trail use monitoring and enforcement.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>								
Hazard 1.13b	Risk – Low	Consequence - 1	Likelihood - C						
Camping  <b>Contaminant(s)</b> Sedimentation, turbidity, coloration Total organic compound	<i>Comments:</i> <ul style="list-style-type: none"> <li>• The concern is primarily camping at Rainbow Lake which naturally has flat sheltered areas next to a water source, making it a desirable camping area.</li> <li>• The risk of campfires increases if there are more recreationalists without alternate approved campsite choices. See Hazard 1.7a and 1.7b.</li> <li>• The risk to water quality from camping is its potential to result in contamination of the water source from such activities as washing dishes/clothing and defecating near water courses due to lack of proximity of outhouses.</li> </ul>								

<sup>15</sup> Sea to Sky Land and Resource Management Plan April 2008

Protozoa, bacteria	<p><i>Risk Management Strategy:</i></p> <ul style="list-style-type: none"> <li>• MFLNRO encouraging camping at Hanging Lake through improved facilities.</li> <li>• Overnight camping is to be discouraged, except for emergency purposes. New formal campsites are to be developed exclusively outside of the watershed, and signage will be used to inform hikers of appropriate camping locations outside of the watershed. Existing camping areas along the Rainbow-Madeley trail will be retained and may be improved to reduce environmental impact from campers. Future recreational development will focus on minimizing the potential for water contamination, such as upgraded toilet facilities, trail maintenance to reduce erosion, and public outreach on appropriate sanitary practices.<sup>16</sup></li> <li>• RMOW to consult with MFLNRO on how to best implement monitoring and enforcement of camping prohibition.</li> </ul>			
	Specific Action Items	Responsible	Proposed Schedule	Estimated Cost
	Per Hazard 1.11 RMOW to work with MFLNRO to establish a means of monitoring trail use and enforcement.	MFLNRO <i>Alistair McCrone</i> RMOW UG <i>Michael Day</i> RMOW Parks Operations <i>Dave Patterson</i>		
<b>Hazard 1.14</b>	<b>Risk – Low</b>	<b>Consequence - 1</b>	<b>Likelihood - E</b>	
Outhouses  <b>Contaminant(s)</b> Bacteria Protozoa	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>• The risk to water quality from the outhouses presently located in the watershed is a concern for VCHA.</li> <li>• The concern of having outhouses in the watershed is that they pose a large single point contamination risk.</li> <li>• The concern of having poorly maintained outhouses is that they will not be used and the concern of</li> </ul>			

<sup>16</sup> Sea to Sky Land and Resource Management Plan April 2008

- not having any outhouses is that trail users could choose poor locations on/off the trail to defecate.
- RMOW will develop and implement a Bio-waste Strategy to address the concerns with outhouses.
  - See Section 4.3.3 of Assessment for further background.

*Risk Management Strategy:*

- To review the present outhouse locations and technologies and develop a Bio-waste Strategy.

Specific Action Items	Responsible	Proposed Schedule	Estimated Cost
Implement a formal Bio-waste Strategy for Twenty One Mile Creek Watershed with preliminary suggestions including: <ul style="list-style-type: none"> <li>• Install an outhouse below the water intake and indicate the preference for Day Hikers to use this facility;</li> <li>• Make a decision on whether to keep or abandon the middle outhouse;</li> <li>• Relocate the outhouse at Rainbow Lake to either outside the watershed or well away from water (at least 300m);</li> <li>• Investigate best technologies for any new and the existing outhouses in order to provide facilities that users will want to use. This may include retrofitting existing outhouses.</li> </ul>	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i>	2015/2016	-
RMOW to work with VCHA and MFLNRO regarding the Bio-waste Strategy. Submit recommendations to VCHA for review prior to any works taking place.	MFLNRO <i>Alistair McCrone</i> RMOW Utilities Group <i>Michael Day</i> RMOW Parks Operations	2015/2016	



		Dave Patterson VCHA Len Clarkson										
Hazard 1.15		Risk - Moderate	Consequence - 2	Likelihood - C								
Snowmobiling  Contaminant(s) Petroleum products	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>If a snowmobile overturned in a creek, the risk to water quality would be from spilled oil that could reach the water supply intake.</li> <li>Snowmobilers are not allowed to enter the watershed; however this does not prevent users from doing so.</li> <li>See Section 4.3.3 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i></p> <ul style="list-style-type: none"> <li>MFLNRO has already approached Canadian Wilderness Adventures and local snowmobile clubs to inform users of the prohibition of snowmobiles in the watershed.</li> <li>"There will be no further expansion of motorized access in the area, in order to maintain the zone for quiet enjoyment by the public."<sup>17</sup> In addition to maintaining the zone for quiet enjoyment of the public, not expanding the area to motorized recreation is in line with the water quality goals in Section 4.6.2 of the S2SLRMP "Meet or exceed existing community and/or local government standards" and with the general wish by the RMOW community to maintain a natural environment.</li> </ul> <table border="1"> <thead> <tr> <th>Specific Action Items</th> <th>Responsible</th> <th>Proposed Schedule</th> <th>Estimated Cost</th> </tr> </thead> <tbody> <tr> <td>If there is an accident which results in leakage of fuel into the watershed, RMOW shall initiate the RMOW Water System Emergency Response Plan.</td> <td>RMOW Utilities Group Michael Day</td> <td>In an emergency</td> <td>Internal</td> </tr> </tbody> </table>				Specific Action Items	Responsible	Proposed Schedule	Estimated Cost	If there is an accident which results in leakage of fuel into the watershed, RMOW shall initiate the RMOW Water System Emergency Response Plan.	RMOW Utilities Group Michael Day	In an emergency	Internal
Specific Action Items	Responsible	Proposed Schedule	Estimated Cost									
If there is an accident which results in leakage of fuel into the watershed, RMOW shall initiate the RMOW Water System Emergency Response Plan.	RMOW Utilities Group Michael Day	In an emergency	Internal									
Hazard 1.16		Risk – Moderate	Consequence - 2	Likelihood - C								
Heli-recreation	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>If a helicopter crashed in a creek, the risk to water quality would be from spilled oil that could reach</li> </ul>											

<sup>17</sup> Sea to Sky Land and Resource Management Plan April 2008

<b>Contaminant(s)</b> Petroleum products	the intake. <ul style="list-style-type: none"> <li>See Section 4.3.3 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i>          “The existing tenure for a heli-ski operation in Twenty-One Mile and is recognized and will continue as the only motorized recreation tenure in the area, with no further expansion of the existing helicopter tenure, and no new motorized recreation tenures. The use of helicopters in and over this area is discouraged during the summer hiking months (June 1 to October 31).”<sup>18</sup></p>			
	Specific Action Items	Responsible	Proposed Schedule	Estimated Cost
	If there is an accident which results in leakage of fuel into the watershed, RMOW shall initiate the RMOW Water System Emergency Response Plan.	RMOW Utilities Group <i>Michael Day</i>	In an emergency	Internal
<b>Hazard 1.17</b>		<b>Risk – Low</b>	<b>Consequence - 2</b>	<b>Likelihood - E</b>
High User Demands  <b>Contaminant(s)</b> Impact to water availability	<p><i>Comments:</i></p> <ul style="list-style-type: none"> <li>The risk to water availability will increase as water use increases.</li> <li>See Section 3.3.4 of Assessment for further background.</li> </ul> <p><i>Risk Management Strategy:</i>          RMOW already has various water use reduction plans in place, as outlined below.</p>			
	Specific Action Items	Responsible	Proposed Schedule	Estimated Cost
	Continue with execution of Annual Water Conservation & Supply Plan	RMOW Utilities Group <i>Michael Day</i>	Ongoing Annually	\$100,000

<sup>18</sup> Sea to Sky Land and Resource Management Plan April 2008

**11. Appendix D. Letter from VCHA July 24, 2015**

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**Health Protection**

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July 24, 2015

To Michael Day – RMOW Manager of Utilities

**Re – Public Health Perspective –RMOW 21 Mile Creek Source Water Protection Plan**

VCH regulates and permits the RMOW Community Water System under the jurisdiction of the DWPA/R. We embrace the multiple barrier approach to drinking water protection in a comprehensive source to tap approach. In this regard all water systems are encouraged to develop source water protection plans as best practice. With regard to the 21 Mile Creek source specifically, the requirement for a SWPP was incorporated as a condition of the RMOW Permit to Operate. This was agreed at the time of upgrading infrastructure to provide enhanced disinfection without filtration, based on bypassing intake water that exceeds 1 ntu of turbidity. In addition to turbidity, reductions to the UV transmissivity (UVT) can also inhibit performance of your disinfection process, also resulting in intake shutdown (typically when it drops below 80%).

From a water quantity perspective, without the benefit of filtration, the 21 Mile Creek source should be considered intermittent. Accordingly we have two concerns:

1. In the event of extreme water system flows, ie a large diameter water main break or extensive firefighting, the RMOW distribution system could become depressurized if this source were off line. This could result in activation of any cross connections and possibly back flow of contaminated water into the distribution grid, and secondly,
2. To maintain adequate fire flow levels in an emergency it may be necessary to override the 1 NTU maximum limit to maintain minimum reservoir levels.

From a water quality perspective we have the following comments:

1. The existing treatment processes in place for the 21 Mile Creek source meet our treatment expectations; however pathogen loading from fecal sources should be minimized wherever possible. Outhouses should be located below the intake or outside of the drainage. If it is deemed that an outhouse is required within the watershed, extreme care should be used in its design, location; maintenance and monitoring. Domestic pets should be excluded from the watershed.
2. Organic materials in the watershed such peat deposits present as source for organic carbon which can reduce UVT if it becomes mobilized. Attempts to stabilize these materials should be made if possible. Deciduous trees such as alder can also present a significant source of organic carbon from leaf decay. Consideration should be given to conversion to conifer species preferentially.

3. Inorganic sedimentary deposits may be found in unstable slope conditions – which are fairly typical in coastal watersheds. A survey of the surficial geology should identify these units and consideration should be given to stabilizing these slopes wherever practical, particularly if they contain finer lacustrine deposits due to their contribution to turbidity if mobilized.
4. Risks from human recreation are difficult to quantify however it seems reasonable to expect that as increased exposure will lead to increased risk. In this regard it seems most appropriate to vet these decisions through the community at large to determine what would be acceptable and reasonable. Additional control measures such as trail access permits could be implemented should you wish to limit volume of public access. Ideally we would enlist these recreational users to be champions in protecting the water resource

In view of the strategic importance of the 21 Mile Creek water supply source, an annual work plan of watershed surveillance and restoration activities should be followed to minimize contamination risks.

Yours sincerely,



Len Clarkson  
Water Specialist and Drinking Water Officer  
Vancouver Coastal Health  
phone 604-815-6841  
[www.vch.ca](http://www.vch.ca)

## **Appendix E. Template for Hike Survey Observation**

### Rainbow Trail Hiking Notes

Date of Hike	
Hiker(s)	
Weather	
Start of Hike	
End of Hike	
Cars in parking lot beginning of hike	
Cars in parking lot end of hike	

### Observations on Day of Hike

Hazard #	Hazard Description	Metric	Photo Location or Count	Photo Number
1.1	Snowmelt and rainfall	Take photo		
1.1	Snowmelt and rainfall	Take photo		
1.1	Snowmelt and rainfall	Take photo		
1.1	Snowmelt and rainfall	Take photo		
1.2	Slope Failure	Take photo if observed		
1.3	Debris Flood	Take photo if observed		
1.4	Rockfall	Take photo if observed		
1.5	Wildlife	Count all		
1.6	Mountain Pine Beetle	Take photo if observed		
1.7	Wildfire			
1.8	Climate Change			
1.9	Roads			
1.10	Forestry			
1.11	Non-motorized Trail Use (NMTU)	Count hikers (include observers)		
1.11	NMTU	Count MTB		
1.11	NMTU	Take photo(s) of any trail erosion		
1.12	Domestic Pets	Count Dogs		
1.13a/b	Campfire/Camping	Count/ Take photo		
1.14	Outhouses	Inspect from bottom to top		
1.15	Snowmobiling	Count (remains of)		
1.16	Heli-skiing	Count (summer fly overs)		
1.17	High User Demands			