WATERSHED MANAGEMENT PLANNING IN A MOUNTAIN RESORT COMMUNITY: A CASE STUDY OF WHISTLER'S CRABAPPLE CREEK

by

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ABSTRACT

Integrated watershed management planning is currently evolving in British Columbia as a means of effectively managing water resources at local and municipal scales. As part of an overall movement towards sustainability, the mountain resort community of Whistler, British Columbia, recently expressed the need for integrated watershed management planning to help protect the quality of valuable water resources and habitat. The Crabapple Creek watershed was selected as the first Whistler watershed to undergo such a process. This research project details the development process and content of the Crabapple Creek Watershed Management Plan.

This research project identifies critical features of effective integrated watershed management plans and applies them to the specific context of Whistler's Crabapple Creek watershed. The development of this research project involved the use of varying methods over two principal stages. The first stage involved a review of literature pertaining to the various topics addressed by the project. The project's methods in the second stage involved procedures for developing the Crabapple Creek Watershed Management Plan, including: collecting and assessing biophysical information; identifying and engaging watershed stakeholders; identifying critical watershed issues; and refining the management plan through stakeholder and external review.

Whistler's world class resort status is deeply rooted in its capacity to provide diverse high quality experiences for residents and visitors in a natural mountain environment. From a tourism perspective, Whistler faces the challenge of hosting tourists in a financially responsible manner without destroying the foundation of its international appeal, the ecological integrity of its local environment. The Crabapple Creek Watershed Management Plan is designed specifically for this tourism and recreation-based community and aims not only to protect the health of the Crabapple Creek watershed, but also to take advantage of the rare opportunities for encouraging environmental mindfulness and stewardship among residents and visitors.

This research identifies some of the unique opportunities and challenges of the Crabapple Creek watershed management planning experience related to the tourism-based character of the Whistler community. Highlighting these challenges and opportunities provides resource managers and decision makers with the occasion to examine differing approaches to integrated watershed management. This opportunity is intended to facilitate the effectiveness of future watershed management initiatives both within the province and beyond.

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LIST OF ABBREVIATIONS

AWARE	Association of Whistler Area Residents for the Environment
BC MELP	British Columbia Ministry of Environment, Lands and Parks
BC MTH	British Columbia Ministry of Transportation and Highways
BMP	Best Management Practices
CCWMP	Crabapple Creek Watershed Management Plan
EIA	Effective Impervious Area
PFC	Proper Functioning Condition
RMOW	Resort Municipality of Whistler
SPA	Streamside Protection Area
TIA	Total Impervious Area
WFSG	Whistler Fisheries Stewardship Group

CHAPTER ONE
INTRODUCTION

This chapter provides an introduction to the principal issues related to this research project. It presents a focus and rationale for the research to be presented in this report. It explains the main project objectives and research questions to be addressed. This chapter then describes the project methods and concludes with an outline of the report structure.

1.1 BACKGROUND AND PROJECT RATIONALE

The protection of our waterways for present and future generations requires appropriate planning and management at varying spatial scales. Integrated watershed management planning is currently evolving in British Columbia as a means of effectively managing water resources at local and municipal scales. As part of an overall movement towards environmental sustainability, the community of Whistler recently expressed the need for integrated watershed management planning designed to protect valuable local habitat and water resources. Crabapple Creek was selected as the first watershed to undergo an integrated watershed management planning process, thereby establishing a model framework for future watershed management initiatives in the Whistler Valley.

The primary rationale for this research project was to fulfil the demand for an integrated watershed management plan for Whistler's Crabapple Creek. While the settings and resource issues that drive local watershed management planning initiatives are diverse, communities often find that similar tools and techniques work in many watersheds. This research project identifies some of those critical features common to effective integrated watershed management plans and then applies them to the specific context of Whistler's Crabapple Creek.

Centrally located in the mountain resort community of Whistler, British Columbia, the Crabapple Creek watershed (4.8km^2) hosts a variety of land uses including commercial

development, residential neighbourhoods, a championship golf course and the Whistler/Blackcomb ski area on Whistler Mountain. Although impacted by urban and recreational development, Crabapple Creek continues to provide the best fish habitat in the Whistler Valley. Crabapple Creek also provides significant opportunities for encouraging environmental learning, mindfulness and stewardship among residents and visitors.

Whistler's world class resort status is deeply rooted in its capacity to provide diverse high quality recreational experiences for residents and visitors in a natural mountain environment. From a tourism perspective, Whistler faces the challenge of hosting tourists in a financially responsible manner without destroying the foundation of its international appeal, the ecological integrity of its local environment. A watershed management plan designed specifically for this tourism and recreation-based community ideally should protect the health of the Crabapple Creek watershed, as well as take advantage of the rare opportunities for encouraging environmental mindfulness among residents and visitors.

The unusual nature of development, demographics, and stakeholders within Whistler's Crabapple Creek watershed provide a distinctive context for integrated watershed management planning. This research project identifies some of the unique opportunities and challenges of the Crabapple Creek watershed management planning experience related to the tourism-based character of the Whistler community. Highlighting these challenges and opportunities provides resource managers and decision makers with the occasion to examine differing approaches to integrated watershed management. This opportunity is intended to facilitate the effectiveness of future watershed management initiatives both within the province and elsewhere.

1.2 PROJECT OBJECTIVES

The primary objective of this research is to develop an integrated watershed management plan for Crabapple Creek in Whistler, British Columbia. The project's secondary objective is to highlight various unique aspects of the development process and content of the

Crabapple Creek Watershed Management Plan related to the tourism-based resort nature of Whistler.

1.3 RESEARCH QUESTIONS

In the context of developing an integrated plan for Crabapple Creek, Whistler, this research addresses two main questions:

1. What are some critical elements of an effective integrated watershed management plan and how can they be applied to the Crabapple Creek watershed in Whistler, British Columbia?
2. What are some unique features of the Crabapple Creek watershed management planning process and content related to the tourism-based resort nature of Whistler?

1.4 OUTLINE OF PROJECT METHODS

The development of this research project involved the use of varying methods over two principal stages. The first stage involved a review of relevant literature pertaining to the various topics addressed by the project. The project's methods in the second stage involved procedures for developing the Crabapple Creek Watershed Management Plan. This development process entailed various methods including: collecting and assessing biophysical information; identifying and engaging key watershed stakeholders; identifying critical watershed issues; and refining the integrated watershed management plan through watershed stakeholder and external review.

1.5 REPORT ORGANISATION

This document is divided into six chapters. Chapter One has presented the rationale for the project, the purpose of the study, research questions and a brief description of the research methods used in this project. Chapter Two provides a literature review in five general areas which are relevant to this project. These include: an introduction to integrated watershed

management planning; recent directions of watershed management planning in British Columbia; critical features of effective watershed management plans; and tourism and mindfulness. Chapter Three provides a detailed description of the methods used to develop the Crabapple Creek Watershed Management Plan. Chapter Four presents the background and content of the Crabapple Creek Watershed Management Plan. Chapter Five offers a reflection on the unique aspects of the Crabapple Creek watershed management planning experience related to its tourism-based resort setting in Whistler, British Columbia. Finally, Chapter Six presents conclusions and recommendations for further research in this field of inquiry.

CHAPTER TWO
LITERATURE REVIEW

This chapter provides a review of the literature related to the various themes and issues addressed by this project. It begins with a definition and brief account of integrated watershed management planning and follows with a description of more recent directions associated with watershed management planning initiatives in British Columbia. Critical features of effective watershed management plans are identified and suggested as a framework for the development of the case study, the Crabapple Creek Watershed Management Plan. This chapter concludes with a synopsis of the literature pertaining to tourism and mindfulness as they relate to watershed management in a tourism destination context.

2.1 INTEGRATED WATERSHED MANAGEMENT PLANNING: AN INTRODUCTION

The health of water resources across the continent has long been deteriorating in response to growth, urban development, and natural resource extraction. Watersheds of every scale are being impacted by our actions, and the toll is revealing itself in numerous ways including the degradation of waterways and the decline of habitat and important fish populations. Partially in response to these negative effects, and more generally as the result of a greater holistic understanding of the environment, resource managers have begun to take a different approach to the management of our natural resources. This *ecosystem management* approach recognises that our environment is a complex, living system that must be managed as an interconnected system rather than simply a collection of separate parts (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995).

Watersheds are areas that lend themselves as natural and logical candidates for ecosystem management (Center for Watershed Protection 1998a; Charlton and Tufgar 1991; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a,

1993b, 1994; Riley 1998; Royal Commission on the Future of the Toronto Waterfront 1990; Schueler 1994b; UMA Environmental 1998). A watershed, or a drainage area, is an area of land defined by its highest elevations from which water, such as rainfall and snowmelt, drains towards a single point. A watershed can be as small as a basin that drains into a tiny creek or as large as the Fraser River basin which drains more than 25% of British Columbia's area (Fraser Basin Council 1997). Watersheds represent a defined area of land in which ecological structure, functions and processes are tightly intertwined and inextricably connected to human activities and land use. In other words, watersheds are bounded regions that may be broadly considered as ecological systems. Watersheds are integrated systems, meaning that effects in one part of the system are not isolated. What happens upstream in a watershed will have effects downstream and surrounding land use can significantly impact the quality of water resources (Center for Watershed Protection 1998a).

Integrated watershed management may be defined as the process of managing human activities in an area defined by watershed boundaries in order to protect and restore land and water resources (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994 and 1993a; UMA Environmental 1998). The concept of integrated watershed management encompasses the ecosystem approach by establishing ecological goals while recognising the benefits of planned growth and development to the social and economic well being of an area (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994 and 1993a). As stated by the Royal Commission on the Future of the Toronto Waterfront (1990),

> traditionally, human activities have been managed on a piecemeal basis, treating the economy separate from social issues or the environment. But the ecosystem concept holds that these are inter-related, that decisions made in one area affect all the others. To deal effectively with the environmental problems in any ecosystem requires a holistic or 'ecosystem' approach to managing human activities (19).

Integrated watershed management planning is a tool to assist land and water use decision makers in making better decisions, contributing to the environmental, social and economic health of an area on a sustainable basis. Integrated watershed management involves making decisions about the amount and location of development and choices about appropriate land

use management techniques. By recognising the hydrologic cycle as the "pathway" integrating physical, chemical and biological processes, it is an ecosystem-based strategy aimed at achieving sustainability (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994 and 1993a; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998).

Integrated watershed management planning is usually employed where: urban development is rapidly spreading into natural areas; areas are under pressure from resource development; communities are experiencing problems with water supply quality or quantity; streams and rivers are prone to flooding or erosion; and where fish and wildlife habitat is being degraded (UMA Environmental 1998). These situations emphasise the connection between land use and water resources, as human activities have a direct influence on the local watershed. The concept of integrated watershed management applies particularly well to the context of rapidly developing mountain tourism resort communities which typically depend heavily on local watersheds for their operating power.

The American Experience

Integrated watershed management planning in the United States has a longer and more institutionalised, legislative history than in Canada. Federally sponsored watershed planning has been occurring in the United States since the 1960s. In 1965, the Water Resources Planning Act came into legislation. It provided for a national Water Resources Council to develop water policy, organise regional and local river basin commissions and provide financial assistance to the states to support state-level planning initiatives (Riley 1998). This movement towards integrated watershed planning was complemented in 1972 by the Clean Water Act which initiated a nation wide program of regional water quality management plans. This Act required the preparation of watershed management plans for all major river basins in the United States (Riley 1998). Riley (1998) describes a "revival of federal interest in watershed-based planning" in the 1990s that is distinguished by the further

integration of water issues, such as water quality, fish and wildlife habitat, water supply, stormwater management, and flood control.

Regional and local watershed planning efforts in the United States advocate the importance of strong state leadership (Economic and Engineering Services, Inc. 1999; Riley 1998). Case studies and conferences on innovations in watershed, floodplain and stream corridor management flourished in the late 1980s and early 1990s. In many states, watershed management plans at the local or regional level are required by state law. Currently, locally based integrated watershed management planning initiatives, both state-sponsored and those developed by non-profit organisations are thriving (Riley 1998). Institutions with a focus on watershed issues, such as the Center for Watershed Protection in Maryland, also provide a force for promoting effective watershed management initiatives in the United States (Center for Watershed Protection 1998b). Such institutions continually provide state of the art research on watershed issues and promote best management practices in land use planning principles and design techniques for protecting and restoring watershed integrity.

Many major ski areas within or adjacent to mountain resort communities operate on lands regulated by the United States Department of Agriculture Forest Service. The recently proposed "Clean Water Action Plan" by President Clinton is anticipated to influence the nature of watershed management in these areas (Sherman and Barrett 1998). This Action Plan emphasises a watershed approach to planning and management and could potentially require ski areas to participate in long-term watershed management planning processes to protect water quality and the health of aquatic and riparian systems (Sherman and Barrett 1998).

The Canadian Experience

Traditionally, the management of water resources in Canada has been "issue-driven, segmented among jurisdictions, and single resource-based. This is difficult, costly, and not particularly effective" (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1997, 3). Unlike the United States, Canada has not promoted

ecosystem-based watershed management through legislation at the federal level. Only in the past decade have efforts been made provincially to implement watershed management as a method of sustainable local land use planning. The Ontario provincial government has been a leader in promoting integrated watershed management initiatives locally and regionally. In the early 1990s, the Ontario Ministry of Environment and Energy and the Ministry of Natural Resources (1993a, 1993b, 1994) published a series of handbooks about watershed management planning. This series emphasises the ecosystem approach in watershed planning and management and suggests various tools and techniques to assist local governments and communities in appropriate watershed management initiatives. The implementation of planning and management initiatives by local governments with a strong focus on ecosystem integrity clearly demonstrates a shift from remediating water resource problems to proactively protecting the environment on a watershed scale.

The practice of integrated watershed management planning in Canada has evolved in recent years to become more comprehensive, integrating a broader range of stakeholders and natural resource protection issues (Curran 1999; UMA Environmental 1998). This recent approach more thoroughly recognises and addresses the important linkages between land and water and between watershed management and local planning. Cooperative, proactive, local integrated watershed management initiatives are becoming more widespread throughout the nation as managers recognise the benefits of these approaches.

2.2 RECENT DIRECTIONS OF WATERSHED MANAGEMENT PLANNING IN BRITISH COLUMBIA

Numerous examples demonstrate that traditionally in British Columbia, water resource management has been largely driven by single resource issues (e.g. forestry and hydroelectricity) and implemented from governments in a top-down approach (British Columbia Ministry of Environment 1988; British Columbia Ministry of Environment 1993; British Columbia Ministry of Environment, Lands and Parks and British Columbia Ministry of Forests 1991). In recent years, however, water resources management in British Columbia has shifted towards a more comprehensive, cooperative, and integrated approach.

Community-based roundtables, councils and alliances provide growing evidence that watershed-based, locally driven planning processes are defining sustainability objectives at a local scale (Cantwell and Day 1996; Romaine 1996).

Unlike the highly legislative approach of the United States, there is still no legal requirement in Canada, provincially or federally, for watershed management planning at any spatial scale. Rather, municipal governments, especially in British Columbia, have recently found themselves at the forefront in devising, adapting and utilising legislative mechanisms for watershed protection. In the past decade, many British Columbian municipalities have been active in adapting policies and legislation to protect and restore local streams from the impacts of urban development (Curran 1999). Recent transformations in provincial legislation are providing new tools and opportunities for local governments to promote environmental stewardship initiatives through legislation. In an attempt to address increasing concerns about the degradation of fish habitat due to urbanisation, changes to the *Municipal Act* in *Bill 26 – Local Government Statutes Amendment Act, 1997*, offer improved municipal powers to restore, protect and enhance local environmental quality (British Columbia Ministry of Municipal Affairs 1998). The new *Fish Protection Act* (*Bill 25*) of 1997 also provides additional planning tools for local governments to protect stream and riparian corridors (British Columbia Ministry of Environment, Lands and Parks 1997).

In addition to employing these recent legislative tools, British Columbian municipalities are increasingly addressing riparian protection and impervious area impacts on an ecosystem scale (Curran 1999). Efforts are moving from isolated policy measures such as Development Permit Areas and minimum riparian protection requirements towards more comprehensive planning and management on a watershed basis (Curran 1999). These efforts are increasingly taking the form of integrated watershed management and integrated stormwater and stream corridor management plans. One example of this new integrated approach involves the Stoney Creek Environmental Working Group, a multi-stakeholder assembly which has recently developed an integrated stormwater management plan for the Stoney Creek watershed in Burnaby. The goal of the plan is to manage stormwater effectively while protecting the aquatic and riparian ecosystems of the watershed (Curran

1999; Stoney Creek Stormwater Steering Committee 1998). Another leading example of integrated watershed management planning can be found in Langley. There, the Salmon River Watershed Management Partnership has developed a comprehensive watershed management plan for the Salmon River, one of the last remaining near pristine salmon producing streams in the Lower Mainland (Giannico and Healey 1998; Salmon River Watershed Management Partnership 1998). Additional examples of integrated watershed management planning in British Columbia have occurred or are currently occurring in Kelowna (Kelowna Area Watershed Initiative – Mill Creek), the Comox Valley (Millard/Piercy Watershed Management Plan), Squamish (Squamish-Cheakamus Rivers Watershed Management Plan), and the Capital Regional District (Craigflower Watershed Management Plan) (Craigflower Watershed Management Forum 1998; Curran 1999; Millard/Piercy Watershed Stewards 1999; Tobe 1999; Wark, Miller and Harper 1999).

Community-Based Watershed Stewardship and Management Initiatives

Public perceptions in British Columbia have suggested that governments are not capable or willing to address the stewardship of our water resources (Litke and Day 1998; Romaine 1996). Outdated and ineffective methods of planning and land use management at all levels of government have resulted in significant impacts to water resources. The following perceived barriers to integrated watershed management in British Columbia have been identified by Romaine (1996): inadequate key information and understanding of ecological processes; inappropriate sectorial management or institutional arrangements for water management; inadequate accounting systems for valuing natural resources; limited planning frameworks and priorities; lack of provincial management responsibilities and commitments; and insufficient monitoring programs. Many of these barriers revolve around the perceived inadequacy of the current jurisdictional framework for managing water resources within the province. As a result, British Columbia has recently seen the emergence of numerous community-based, locally driven watershed planning initiatives to address the growing concern for appropriate stewardship of water resources. These initiatives have taken the form of community roundtables, councils and alliances (e.g. Salmon River Watershed Roundtable, Salmon Arm) aimed at protecting the integrity of

local watershed resources. These initiatives have largely been initiated by community citizens, often involving local governments after momentum has been gained (Litke and Day 1998; Romaine 1996). As governmental agencies shift towards a more collaborative, watershed-based approach to the management of water resources throughout the province, community-based initiatives are also evolving to incorporate such partnerships.

2.3 CRITICAL FEATURES OF EFFECTIVE INTEGRATED WATERSHED MANAGEMENT PLANS

Many watershed management plans have been produced in North America in the past decade. Integrated watershed management plans aim to guide the long-term management of land and water interactions to protect the health of the watershed ecosystem. They provide a framework to restore, protect and maintain a healthy watershed, balancing ecological, social and economic needs. Unfortunately, many of these plans have been ineffective in bringing about the visions they sought to achieve. Aptly stated by Schueler (1995b),

> a local watershed management plan is arguably the most comprehensive tool to protect urban streams from the cumulative impact of land development. In practice, however, few such plans have actually realized this goal. Rather, most watershed plans are but a one-time report that is quickly consigned to the bookshelf, where recommendations languish in obscurity, never to be read or implemented" (33).

Schueler presents a critique of local watershed management plans, outlining some common reasons why they "end up on the shelf" and some key elements common among effective plans. This section presents some of the principal issues and critical features as identified by Schueler and others. They concern the scale of watershed being considered, structure and components of the plan, stakeholder involvement, and the consideration of important biophysical issues.

2.3.1 WATERSHED SCALE

According to Schueler (1995b), the number one reason local watershed management strategies prove ineffective is that the plans are conducted at too great a scale. As

watersheds may be considered at various geographic scales, it is important to select a scale appropriate for the management objectives at hand (Schueler 1995b; UMA Environmental 1998). When watershed management plans address large drainage basins, the focus of the plan may be become "fuzzy", with too many sub-watersheds and varying land use conditions to be considered (Schueler 1995b; Schreier et al. 1997). Schueler describes how planning for larger watersheds often results in an increase in the number of stakeholders involved but a decrease in implementation responsibility. In such cases, the costs for watershed analysis and monitoring are elevated. Managers are faced with a baffling array of issues and problems which are much more effectively dealt with when broken down into smaller, more manageable watershed units (Schueler 1995b).

In their watershed management planning handbook series, the Ontario Ministry of Environment and Energy and the Ontario Ministry of Natural Resources (1993a, 1993b, 1994) initially separate planning efforts according to *watershed* and *sub-watershed* scales so as to avoid planning efforts towards excessively large basins. These publications, however, do not specify a range of areas (i.e. km^2) to distinguish between watershed and sub-watershed scale. The Center for Watershed Protection (1998) and Schueler (1995b) promote the *sub-watershed* as the primary planning unit for watershed management, defined as ranging from 1-15 square miles in area (1.6-105 km^2). The sub-watershed unit is preferred here for several reasons: the influence of impervious cover on hydrology, water quality and biodiversity is most evident at this scale; the influences of individual development projects are easily recognisable; sub-watersheds are likely to have fewer political jurisdictions where it is easier to incorporate all stakeholders into the management process; few confounding pollution sources are present to confuse management issues; and it is small enough to perform mapping, assessment and monitoring tasks in a relatively rapid time frame (Center for Watershed Protection 1998a, 15). Schreier et al. (1997) advocate that management planning efforts are most effective when prepared for watersheds between 10 and 200km^2 in area. They claim that as the causal relationships between land use and ecosystem health are difficult to determine in larger watersheds and smaller watersheds are inefficient as management units. Determining an appropriate geographic scale therefore plays a critical

role in determining the potential efficacy of the watershed management plan being considered.

2.3.2 PLAN STRUCTURE AND COMPONENTS

Vision, Objectives and Actions

The United States Environmental Protection Agency (1997), in cooperation with representatives from River Network, Know Your Watershed, and the Center for Watershed Protection, developed a list of "Top 10 Watershed Lessons Learned" (United States Environmental Protection Agency 1997). The aim of this list is to assist watershed managers and practitioners in learning about different approaches to integrated watershed management, namely, what works and what does not. The watershed lesson at the top of this list reads "the best plans have clear visions, goals, and action items" (United States Environmental Protection Agency 1997). These three components are essential in a watershed management plan (United States Environmental Protection Agency 1997; UMA Environmental 1998).

First, the *vision* describes the overall picture of the desired state of the watershed in the future. A vision statement may be expressed in simple terms and should be comprehensive enough to capture the essence of the overall aim of the watershed initiative. Clear visions help watershed groups understand, relate to, and support protection and restoration efforts (Ontario Ministry of Environment and Ontario Ministry of Natural Resources 1994; Still Creek-Brunette Basin Working Group 1996; United States Environmental Protection Agency 1997; UMA Environmental 1998).

Next, specific *objectives* should be established for the watershed. Objective setting is among the most important steps in watershed planning as it sets out clear directives for watershed managers and practitioners to work towards. These objectives are less general than the vision and describe what conditions are required to attain the vision. They focus the direction for management. (Ontario Ministry of Environment and Ontario Ministry of

Natural Resources 1994; UMA Environmental 1998; United States Environmental Protection Agency 1997). For example, a watershed vision may describe the desire for an "ecologically healthy watershed". The objectives would then describe the components of an ecologically healthy watershed, such as intact, protected riparian systems or a sustainable population of fish and invertebrates.

Once established, each specific objective should then be accompanied by a set of *action* items or tactics that will help achieve that objective. Actions comprise the steps towards reaching the objectives (Ontario Ministry of Environment and Ontario Ministry of Natural Resources 1994; UMA Environmental 1998). They describe who (responsible stakeholder) will do what (specific action), when (timeline) and where (Ontario Ministry of Environment and Ontario Ministry of Natural Resources 1994; UMA Environmental 1998; United States Environmental Protection Agency 1997). Examples of action items might include implementing riparian setbacks, removing culverts, or installing stormwater retention ponds. Both the objectives and the actions detailed in a watershed management plan should be flexible and may be reviewed and adapted over time to reflect changing conditions or knowledge of the watershed practitioners (UMA Environmental 1998).

Monitoring

Integrated watershed management plans should provide criteria against which future successes or failures can be measured. Changes should be measured, communicated and accounted for (Center for Watershed Protection 1998a; Craigflower Watershed Management Forum 1998; Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994; Romaine 1996; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998; United States Environmental Protection Agency 1997). Biophysical or environmental monitoring provides feedback on the performance of the tools used to achieve watershed objectives. It indicates how a stream or watershed is responding to the management practices outlined in the plan (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994; Schueler 1995b). Baseline or existing biophysical conditions for selected indicators must

first be established to provide a context against which to measure changes in the system. Sampling of these indicators must then be conducted consistently and at appropriate time scales as per the nature of the indicators. Monitoring results should then be used to identify needs for modifying implementation of the watershed management plan (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994). Monitoring can be costly and communities must be strategic about what, when, where and how they intend to review progress towards specific objectives.

In addition to monitoring environmental or biophysical indicators, the performance of the integrated watershed management plan and the achievement of its objectives and actions should also be monitored (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994; UMA Environmental 1998). The vision and objectives stated in a watershed management plan, although defining desired future conditions, reflect current environmental, social and economic conditions. They may need modification to address new issues or to reflect recent changes in technology or watershed conditions. Periodical progress reports should also be completed, identifying and evaluating the effectiveness of actions which have been carried out and prioritising remaining or new actions (UMA Environmental 1998). It is important to recognise that effective integrated watershed management is an iterative process. Lessons learned from monitoring the performance of the plan should be used to make appropriate revisions (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994).

Implementation

Integrated watershed management plans can only be effective if they are implemented. Integrated watershed management planning initiatives should incorporate an implementation strategy (Center for Watershed Protection 1998a; Craigflower Watershed Management Forum 1998; Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a, 1994; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998). This often involves the creation of some type of organisational or management structure responsible for guiding the

development and implementation of the watershed plan over time. The established organisation responsible for implementing and fostering the plan should be comprised of key stakeholders and decision makers (e.g. local government, First Nations, and critical land users such as tourism/recreation managers) and representatives from the watershed community as a whole (e.g. residents, non-governmental organisations, and tourism operators). The implementation responsibilities of such a committee might include: ensuring that those stakeholders responsible for specific tasks are upholding their duties in a timely manner; assessing the results of monitoring and adapting the recommendations of the plan accordingly; contacting relevant agencies for funding opportunities; suggesting further required studies or action items; communicating the progress and performance of the plan to all stakeholders; and reviewing and updating the plan according to changing watershed values, conditions or information (Centre for Watershed Protection 1998; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; Still Creek-Brunette Basin Work Group; UMA Environmental). Having a principal coordinator to lead such a committee and facilitate the management planning and implementation process is desirable (United States Environmental Protection Agency 1997; UMA Environmental 1998).

It is crucial to establish a management structure that can be sustained over the life of the watershed planning and management process. This can be achieved in part though involving key watershed stakeholders from the beginning of the planning initiative, fostering local ownership of the plan and familiarising them with the process and components of watershed management (Center for Watershed Protection 1998a). Having the involvement and support of local governments can also prove critical in implementation, especially in cases where plan recommendations concern municipal policy, planning and development issues (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a, 1993b; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994).

One potential instrument to help promote coordination and effective implementation of watershed management plans is political agreements among key watershed stakeholders.

The signing of such agreements, often known as memorandums of understanding, can help to legitimise watershed management partnerships and commitments (Center for Watershed Protection 1998a). These agreements define how government agencies and other key stakeholders will work together to create and sustain the watershed planning and management effort. As statements of intent between parties, they help to formally foster watershed management responsibilities which will assist in achieving the watershed vision, objectives and recommendations developed and agreed upon by stakeholders.

Budget

Watershed management plans should include a financial budget which estimates the cost of implementing the recommended watershed actions (Center for Watershed Protection 1998a; Schueler 1995b; UMA Environmental 1998). Unfortunately, fiscal resources for watershed protection and restoration are often limited and watershed managers must make careful choices about how to allocate scarce dollars (Center for Watershed Protection 1998a). The budget might include suggestions for how the actions might be funded (e.g. stakeholders, grants). Due to the diverse nature of watershed management plans and various funding sources available, it is difficult to establish a simple standard funding formula (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a). Watershed managers must therefore be both practical and innovative in devising a workable budget and securing funding for projects (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a). It should be remembered, however, that although watershed protection and restoration costs money, it is a long-term investment in the preservation of natural capital, the quality of our environment.

Public Education

A well-informed public will support and help implement a watershed management plan. A public education component should be developed early as part of the stakeholder involvement process when developing a watershed management plan. Establishing a

dialogue with the watershed community is essential in determining key values, issues, concerns and interests that will contribute directly to shaping the watershed management plan (Craigflower Watershed Management Forum 1998; Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; United States Environmental Protection Agency 1997; UMA Environmental 1998; United States Environmental Protection Agency 1997). Although not all stakeholders within a watershed will become involved in the development process of a management plan, they should be kept informed of initiatives and management strategies that may affect them.

Informing the public about watershed management issues and initiatives can result in increased stewardship by community residents. The more aware residents are about watershed issues, the more active they can be in protecting and restoring the ecological integrity of local watersheds. An informed watershed community can be invaluable in detecting changes in watershed conditions and in helping assess the effectiveness of watershed management strategies recommended in the plan (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; UMA Environmental 1998). Community volunteers, such as local Streamkeepers groups, have proven fundamental to numerous watershed monitoring and restoration initiatives throughout British Columbia.

Public education can take many forms, including printed materials such as information brochures and newsletters, displays at public locations, and open house meetings. Coordination with local schools can provide children and teachers with opportunities to learn about and participate in watershed management initiatives. Internet sites are becoming an excellent means of reaching diverse audiences and sharing local experiences with others around the world. Watershed tours, interpretive strategies, demonstration sites, and coverage of watershed issues in the local media also provide opportunities for public learning (Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; UMA Environmental 1998).

Size and Simplicity

Schueler (1995b) identifies length and complexity as a primary source of the ineffectiveness of many local watershed management plans. He notes examples of documents running into several hundred pages, or even several volumes. While watershed management plans have much to communicate in the way of biophysical conditions, management strategies and monitoring indicators, they should be concise enough to be manageable. Key issues and recommendations must be clear and understandable, and should not require watershed managers and practitioners to sift through undue information. Excessive length and complexity, technical or otherwise, tend to obscure the real issues and intimidate stakeholders and other readers (Schueler 1995b). A watershed management plan that is too long and complicated is more likely to be ignored than implemented effectively.

2.3.3 STAKEHOLDER INVOLVEMENT

Watershed management can be complex, as watersheds often span multiple political or administrative jurisdictions and public and private land. Activities in one part of the watershed affect other areas in the watershed. Protecting the ecological health of the watershed, therefore, requires coordinated action on the part of watershed stakeholders. The participation of watershed stakeholders in watershed management planning can help define a collective vision and objectives for the watershed and develop strategic ways of reducing the cumulative impacts of activities.

Watershed stakeholders are defined as any agency, organisation or individual that is involved in or affected by the decisions made in the watershed planning and management process (Center for Watershed Protection 1998a). These can include local governments, land users, residents and property owners, citizen associations, conservation and environmental advocacy groups, developers, outdoor recreation clubs, tourism operators and business interests. All stakeholders should be provided the chance to participate in watershed management planning. The early and continued involvement of watershed stakeholders is one of the most significant tools for achieving the support and commitment needed to develop and implement the watershed management plan (Black 1999; Center for

Watershed Protection 1998a; Craigflower Watershed Management Forum 1998; Jamieson 1996; Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994; Romaine 1996; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998; Wark, Miller and Harper 1999).

Multi-stakeholder processes can be difficult and time consuming. In some cases, it is often the first time that diverse stakeholders interact cooperatively and work towards shared objectives. As differing perspectives are put forward through these cooperative efforts, discord may arise and require facilitation or conflict resolution skills. Without communication, cooperation, and commitment among watershed stakeholders, however, effective watershed management strategies may be difficult or impossible to develop and implement. As stated by Bowers (1999), "long-term, effective watershed management requires 25% science and technology, and 75% human psychology and sociology" (11). This is especially important in a mountain resort community context, as the preservation of the natural resource base, often the foundation of the resort community's success, requires the involvement and cooperation of all watershed stakeholders.

In a resort community context, the notion of stakeholder involvement becomes critical and complex because of the "multi-agency, multi-jurisdictional nature of tourism" (Gill and Williams 1994). Managers are faced with balancing the need to control forms of tourism which potentially jeopardise the sustained use of limited resources with other desires to maximise growth and gather the benefits of increased resident/visitor use (Gill and Williams 1994). These communities in particular must seek to involve all stakeholders in planning initiatives in order to effectively manage and maintain the quality of the watershed resource base. The notion of environmental quality as a destination positioning attribute should also not be overlooked. The high quality of mountain tourism environments is an important business resource for tourism operators. This provides incentive for tourism stakeholders to become involved in integrated watershed management planning initiatives, as such efforts are, in effect, investments in the sustained future of their ventures. Mountain tourism

communities are distinct from other places (Gill and Williams 1994). Integrated watershed management has proven useful in other settings and there is a need to explore the potential of such initiatives for uniting stakeholders and effectively managing watershed resources in an integrated manner in mountain resort communities.

Building Partnerships

Partnerships can be very effective in watershed management planning initiatives where there are often a large number of diverse stakeholders (Black 1999; Romaine 1996; UMA Environmental 1998; United States Environmental Protection Agency 1997). Partnerships formed between groups and individuals who are interested in or affected by watershed issues are a means of identifying and incorporating various issues and perspectives related to local watershed management planning. Partnerships can provide efficient use of technical and financial resources to accomplish tasks that may be difficult for one person or agency. Partnerships build understanding as relationships develop between participants and the diverse perspectives held by partners can foster creative problem solving to watershed issues (Romaine 1996; UMA Environmental 1998). In a tourism destination context, strategic partnerships can be an especially powerful means of aligning priorities and effecting positive change throughout the resort community. For example, *One Whistler* is a partnership alliance between the Resort Municipality of Whistler, Tourism Whistler (the resort community's principal marketing organisation) and Whistler/Blackcomb ski area. This partnership unites these three major stakeholders in organising and mobilising strategic initiatives to benefit the resort community as a whole.

2.3.4 BIOPHYSICAL ISSUES

A number of biophysical issues have emerged as critical in integrated watershed management planning initiatives. The importance of riparian integrity and impervious area as key indicators of watershed health are significantly shaping watershed management planning objectives and strategies. Stream restoration and stormwater management initiatives show increasing recognition of the importance of a watershed approach. This

section provides an introduction to these biophysical issues and their relevance to effective watershed management planning.

Riparian Areas

An integrated approach to watershed management recognises that riparian conditions may have significant impacts on the quality of stream health. Good riparian habitat is a necessary condition for healthy streams. Studies have shown a strong correlation between the biotic integrity in streams and the proportion of stream with intact riparian forest (Millar et al. 1997). A critical component of watershed integrity, riparian vegetation provides many of the requirements for fish bearing streams (Kauffman et al. 1997; Malanson 1993; Millar et al. 1997; Schreier et al. 1997; Schueler 1995a; United States Department of the Interior 1998; Yates 1988; Zandbergen 1998). Some of the essential functions that natural riparian vegetation performs for streams include:

- providing stream bank stability and preventing erosion/sedimentation;
- providing large organic debris (mature growth) needed to sustain stream morphology, complexity and oxygenation;
- helping to control sediment movement within streams;
- maintaining floodplain processes;
- providing small organic debris and terrestrial insects (nutrition for fish and invertebrates);
- filtering pollutants from runoff and groundwater flows;
- providing microclimate modification (shade);
- providing cover for fish to hide from predators;
- maintaining better water depth and annual flow cycle; and
- providing more biodiversity and productivity (Millar et al. 1997; Schreier et al. 1997; Taccogna and Munro 1995; Yates 1988; Zandbergen 1998).

Recently a subject of debate within this field of inquiry is the architecture, or structure, of riparian buffers. An extensive review of the literature by Miller et al. (1997) describes the range of riparian buffer widths required to protect the various beneficial functions

mentioned above. Riparian buffers of 10m in width or less are shown to have very limited effects in terms of providing these beneficial functions. The standard 30m riparian buffer, frequently used in urban development guidelines and municipal bylaws (Department of Fisheries and Oceans Canada 1994), is inadequate to attain all the benefits of a protective riparian zone. There are significant added benefits to the structure and ecology of streams with a larger riparian buffer (Millar et al. 1997; Zandbergen 1998).

Riparian integrity is vital to the health of any stream system. Now widely recognised as a key indicator of watershed health, the protection and restoration of riparian areas has become a high priority for stream protection and watershed management planning initiatives (Kauffman et al. 1997; Quadra Planning Consultants Ltd. 1995; Schreier et al. 1997; Zandbergen 1998). Without significant emphasis on the functional integrity of riparian systems, integrated watershed management planning would fail to address a critical component of stream and watershed health.

Impervious Areas

Not only is stream health directly connected to the condition of its riparian corridors, but also to the conditions and land use within the watershed as a whole. Many research initiatives have explored the correlation between urbanisation and stream health. Results indicate that land use changes such as high and low density development can have dramatic effects on stream integrity. As land uses become altered from natural states to developed conditions, the imperviousness of the watershed increases. The amount of land transformed by development into impervious surface is widely recognised as having significant impacts on stream flows, water quality and channel hydrology. Impervious surfaces, such as paved roads, rooftops and highly compacted soils, reduce infiltration into underlying soils, increasing the both the rate and amount of surface runoff entering stream channels (Harbor 1994; Leopold 1968; Schueler 1995a).

An increase in the impervious area of a watershed amplifies the relative extremity of peak and low flows, frequently resulting in elevated flooding and habitat concerns (Booth 1990;

Richter and Schultz 1988; Weiss 1990). Research has consistently shown declines in the integrity of streams with increasing levels of imperviousness (Harbor 1994; Leopold 1968; Schueler 1994a, 1995a; Zandbergen 1998). Results depict a fairly rapid decline occurring between 10% and 25% imperviousness as recognised stream health indicators decline from good to poor. Several studies report a threshold of around 10% imperviousness below which the detrimental measured effects are small or absent. At higher levels of imperviousness, the decline slows as impacts are already significant (Zandbergen 1998).

While the impact of impervious areas on stream health has been recognised for several decades, recent years have seen a much stronger recognition of imperviousness as an indicator of overall watershed health. A measurement of "total impervious area", the total percent area of a basin where water does not infiltrate the soil, is becoming more commonly utilised as a key indicator of watershed health and in developing appropriate management strategies (Arnold and Gibbons 1996; Claytor and Brown 1996; Schueler 1995b; Zandbergen 1998). Best management practices, state of the art innovative actions that can be taken to improve the efficiency and effectiveness of activities and planning (Bisson et al. 1992), developed and adopted by consulting firms, municipal governments and research institutions such as the Center for Watershed Protection continue to demonstrate innovative policies and practices for minimising impervious areas and their impacts on waterways.

Stream and Watershed Restoration

To date, there have been relatively few examples of lasting, effective stream and watershed restoration projects (Roper, Dose and Williams 1997). One of the primary reasons many projects have not fully succeeded has been that projects are implemented on a small scale, stream or site-specific basis. Riparian and stream ecosystems in developed areas have largely been degraded by off-channel, watershed-wide activities and might for that reason not be effectively restored by focusing solely on modifications within the channel (Brouha and Chappell 1997; Reeves et al. 1991; Roper, Dose and Williams 1997).

Stream restoration will have a greater chance of being effective in the long term if planned, implemented and monitored at a watershed scale (Brouha and Chappell 1997; Reeves et al. 1991; Roper, Dose and Williams 1997). Taking a watershed approach to restoration implies recovering the fundamental natural channel hydrology to improve local habitat conditions. To do this, stream restoration projects must be expanded beyond isolated instream projects to include rehabilitation of upslope and riparian conditions that cause downstream fish bearing stream habitats to decline (Brouha and Chappell 1997; Roper, Dose and Williams 1997). This is especially important in mountain tourism destination where development (e.g. logging, construction of major ski areas, and upslope urbanisation) often detrimentally affects the condition of important headwater streams, areas frequently ignored in restoration efforts (Dorward 1990).

This watershed-based approach to restoration is linked to the concept of *ecological restoration*, "the reestablishment of processes, functions, and related biological, chemical, and physical linkages between the aquatic and associated riparian ecosystems; it is the repairing of damage caused by human activities" (Kauffman et al. 1997, 12). Kauffman et al. (1997) discuss the first critical step in ecological restoration, the cessation of those human activities causing the damage and/or preventing ecosystem recovery. This step acknowledges the capacity for ecosystems to recover naturally when negative stressors are removed. However, it is often the case that channel restoration and instream manipulations are performed without ceasing the degrading land use activities within the watershed (Kauffman et al. 1997). Ecological restoration of streams should be undertaken at the watershed scale, recognising that riparian and stream ecosystems have largely been impacted by off-channel, watershed-wide activities. These are the activities which must be addressed for restoration to be effective in the long term. In this sense, watershed restoration can be successfully addressed through integrated watershed management.

Stormwater Management

Holistic watershed management planning initiatives have recently been occurring in urban environments where natural channel and stream system characteristics have been altered by

development. In the mid-1970s, a major shift in drainage planning philosophy occurred, as engineers began to acknowledge that upstream activities have downstream impacts. Prior to this, the common approach to urban drainage management and design was to simply collect stormwater runoff in an underground pipe system and remove it from the drainage basin as quickly as possible. With this change in thinking, however, the focus in drainage planning has shifted towards drainage planning that performs the historic function of protecting property and allowing developed land use while at the same time sustaining natural riparian and aquatic systems (Stephens 1999; Stoney Creek Stormwater Steering Committee 1998).

This approach to drainage planning, often called "integrated stormwater and stream corridor management", represents a shift towards ecosystem-based management. This approach views ecosystem components and functions in a broader context integrating environmental, economic and social concerns and aims to develop strategies for creek systems that are hydrologically and technically sound and environmentally sensitive (Stephens 1999; Stoney Creek Stormwater Steering Committee 1998). Integrated stormwater and stream corridor management addresses four main factors limiting the ecological values of urban streams. These factors are changes in hydrology, disturbance of the riparian corridor, disturbance of aquatic habitat, and deterioration of water quality (Emery, Derry, Stephens and Baisley 1998; Stephens 1999; Stoney Creek Stormwater Steering Committee 1998). The broad objectives of an ecosystem-based integrated stormwater management strategy approach are to: protect property from flooding; control stream erosion and sedimentation; protect the ecosystems within the stream corridors; reduce post development drainage impact on the receiving environment; enhance storm runoff quality for aquatic life; and increase public awareness of the role of stewardship (Stephens 1999; Stoney Creek Stormwater Steering Committee 1998).

This approach to urban drainage planning provides useful concepts for watershed management planning. The constant development of best management practices within this field provides numerous tools for many aspects of integrated watershed management. Both methodologies recognise the inherent connection between land use within the watershed and

stream corridor conditions. This recognition is critical for devising appropriate management strategies to ensure the continued health of riparian and aquatic resources.

2.4 TOURISM AND MINDFULNESS

Maintaining the quality of the natural resource base is critical to the continued sustainability of most tourism destinations. Especially in mountain regions, the "essential spirit of place" which draws tourists and residents alike to seek such environments should not be compromised (Gill and Williams 1994). Principles of sustainable tourism have become increasingly important as tourism destinations continue to expand. Sustainable tourism identifies conventional tourism as "an eternal triangle of forces, with host communities and habitats, visitors and tourism businesses in an unstable relationship. In such situations, the growth requirements of the industry can lead to the domination of host areas by visitors and tourism businesses. The aim of Sustainable Tourism is to bring the opposing forces of the triangle into equilibrium" (Lane 1991, 2). Inskeep (1991) defines sustainable tourism as providing a quality experience for visitors, while enhancing the quality of life of the host community and protecting the quality of the environment.

In mountain tourism environments, the quality of the natural resource base largely concerns the headwaters of river basins. Sustainable tourism efforts in these areas must be especially concerned with maintaining the quality of mountain watershed resources. Communities depend on the freshwater descending from mountains for drinking, domestic and industrial use, and hydropower while fish and wildlife depend on these headwater systems for critical habitat requirements (Mountain Agenda 1998). Managing increasing demands for fresh water, preserving biodiversity and habitat created by mountain headwaters, and recognising the interactions between mountains and lowlands are challenges which can be met in part by implementing integrated watershed management planning at local and regional scales (Mountain Agenda 1998).

The necessity for tourism management that is sensitive to natural and cultural heritage and host communities is exemplified by a growing number of sustainable tourism initiatives

around the world (Hawkes and Williams 1993). Sustainable tourism is becoming more connected with education and learning, as the industry strives to meet the demands of an increasingly mature and aware visitor market (Lane 1991; Leslie 1998). Urry (1990) suggests that the primary feature of all tourism is that it involves looking at and learning about other places and people. "Holidays are not so straightforwardly contrasted with education and learning as in the past. In a wide variety of ways much tourism is coming to be more closely interwoven with learning" (Urry 1990, 154). For a growing number of people, vacations and recreation are perceived as chances to stimulate and not switch off the brain (Gibson 1998). The tourism industry has recently begun to acknowledge the educational, recreational and management values of interpretation (Knudson, Cable and Beck 1995). Lane explores the connection between the increasing concern for sustainable tourism management and the role of interpretation. Lane (1991) proposes that interpretive plans be established within visitor management strategies which seek to optimise visitor enjoyment, minimise environmental damage and maximise community benefit. Lane (1991) and Moscardo (1996b, 1999) emphasise the need within the tourism industry – in relation to both visitors and managers – for education designed to promote environmental awareness and stewardship. In this way, tourism management can hope to partially address the growing need for sustainability at both local and global scales.

Mindfulness

Moscardo, working in the fields of tourism, recreation and environmental psychology, has introduced the notion of *mindfulness* to tourism management. Drawing on the work of Langer (1989), she (1999) suggests that visitors can be either "mindful" or "mindless". A "mindless" state is characterised by mental passivity and behaviour involving little questioning or processing of new information. In contrast, a "mindful" state is characterised by active mental processing involving the creation of new cognitive groupings (Moscardo 1999; Moscardo and Pearce 1986). Mindfulness is a state of being open to new ways to behave. Mindfulness is associated with more learning, better decision making and feelings of control and enjoyment (Moscardo 1999). Moscardo (1999) proposes the following five principles for encouraging mindfulness: help visitors find their way around; make

connections to visitors and get them involved; provide variety; tell a good story that makes sense; and know and respect visitors. Moscardo (1996b) argues that mindfulness, an "integrating concept", can be used to enhance the quality of visitor experience and work towards sustainability in tourism settings.

Interpretation: Fostering Mindfulness

Interpretation is widely recognised as a valuable tool for communicating information, fostering education, and promoting attitudinal and behavioural change towards mindfulness and stewardship (Biggs and Roth 1986; Moscardo 1996a, 1996b; Sharpe 1976; Sharpe and Gensler 1978; Stewart, Hayward and Devlin 1998; Tilden [1957] 1977). Interpretation is defined by Tilden ([1957] 1977) as "an educational activity which aims to reveal meaning and relationships through the use of original objects, by firsthand experience and by illustrative media, rather than simply to communicate factual information" (8). Interpretation is the translation of information into understandable terms (Wagar 1973). Interpretation should be a synthesis of education, communication, participation, provocation and inspiration. Interpretation generally includes initiatives such as visitor centres, information brochures, signs and displays, and guided activities.

Tilden ([1957] 1977) proposes the following key principles for effective interpretation: provide a personal connection; present information in understandable terms; recognise interpretation as an art of communication ("the story's the thing"); provoke as well as instruct; and focus on the whole rather than parts. Moscardo (1996b) presents similar principles for effective interpretation based on visitor/audience research: provide variety and design difference into interpretive experiences; provide personal experiences; provide opportunities to participate and interact; organise orientation; provide clear content through connections; and allow for a variety of audiences. These principles remain prevalent throughout traditional and recent interpretive literature (Knudson, Cable and Beck 1995). Interpretive initiatives commonly involve the telling of stories or emphasising themes and messages to inspire learning.

Often associated with leisure and outdoor recreational activities, interpretation is instrumental in enhancing visitor appreciation of a place (Knudson, Cable and Beck 1995; Lane 1991; Wagar 1973). Interpretation also has the potential to achieve various objectives relating to tourism and resource management such as enhancing recreational experiences, facilitating user education, and reinforcing management goals (Biggs and Roth 1986; Knudson, Cable and Beck 1995; Lane 1991; Sharpe and Gensler 1978; Wagar 1973). Sharpe and Gensler (1978) demonstrate how interpretation is an effective tool for managing visitor behaviour. Effective interpretation can often overcome ignorance and disregard for management directives simply by explaining the reasoning behind them (Sharpe and Gensler 1978).

Beyond these benefits, interpretation aims to stimulate, facilitate and enhance people's understanding of a place to develop empathy towards conservation (Biggs and Roth 1986; Lane 1991; Sharpe and Gensler 1978; Stewart, Hayward and Devlin 1998; Tilden [1957] 1977). Tilden ([1957] 1977) proposes that through interpretation comes knowledge, from knowledge comes understanding, from understanding comes appreciation, and from appreciation comes conservation. Moscardo (1996b) bases much on the premise that the key to ensuring the quality of the tourism experience is interpretation. She argues that effective interpretation is critical for bringing about both the effective management and conservation of sites and sustainable tourism itself.

The premise that effective interpretation can help bring about attitudinal change is critical to the notion of visitor mindfulness as proposed by Moscardo. As Moscardo (1996b) notes, while tourists are often cited as the cause of many negative ecological and cultural impacts, discussions of improving the nature of tourism should, but rarely do, inherently include a consideration of improving the nature and behaviour of tourists. As significant natural landscapes increasingly become threatened by development, interpretation becomes progressively important in facilitating mindfulness and encouraging a deeper respect for the many values of such heritage. Interpretation can perform a critical role in sustainable tourism by educating tourists about the nature and culture of the host region, by "informing

them of the consequences of their actions, enhancing their experience and encouraging them to engage in sustainable behaviors" (Moscardo 1996b, 378).

In tourism communities, it is important to acknowledge the potential importance of interpretation to both visitors and residents. While interpretive activities are most often associated with tourists, it can be just as effective, if not more, in fostering education and mindfulness in residents. Moscardo (1992) shows, through visitor evaluation research, that those who are familiar with a setting are more likely to learn something than those who are unfamiliar with the setting because they are better oriented. Residents and frequent or long-term visitors, therefore, are potentially more receptive to interpretive media. It is critical to encourage mindfulness on the part of residents and frequent or long-term visitors, as they are apt to be more directly connected to the daily conservation of the local environment. An increase in resident mindfulness will arguably translate into increased mindfulness on the part of visitors as a result of interactions with members of the host community.

The challenge for managers is to ensure that tourism and recreation are rewarding and sustainable for both hosts and guests and that the quality of the environment is maintained. Interpretation can play a critical role in creating mindfulness among residents and visitors, a necessary condition for sustainable tourism. Public education and interpretive strategies comprising part of an integrated watershed management planning initiative can encourage mindfulness about watershed issues among residents and visitors and contribute to sustainable tourism in a mountain resort community.

CHAPTER THREE
PROJECT METHODS

This chapter describes the methods used for this research project. The chapter is divided into two sections. The first section expresses the rationale for the initial literature review. The following section describes the methods used in developing the case study, the Crabapple Creek Watershed Management Plan. These methods included various approaches to: collecting and assessing biophysical information; engaging watershed stakeholders; identifying critical watershed issues; and refining the draft through a continuous dialogue with key stakeholders and relevant experts.

3.1 LITERATURE REVIEW

Before commencing to develop a watershed management plan for Crabapple Creek, Whistler, it was first necessary to gain an understanding of the basic principles and framework for current trends in integrated watershed management planning. For this purpose, a literature review was conducted to collect and assess relevant information. The information found during the literature review largely helped shape the process and strategies of the Crabapple Creek Watershed Management Plan.

The literature reviewed related to several areas of interest. The first area of focus addressed in the review was the concept of integrated watershed management planning. The literature review then explored recent directions of watershed management planning in British Columbia. In this phase of the literature review several critical features of effective watershed management planning were identified. These included features relating to: structure and composition of watershed management plans; stakeholder involvement and commitment; policy implications; monitoring; and various biophysical issues of importance in watershed management initiatives.

The final topics considered in the literature review were the links between tourism, education and mindfulness. The rationale of investigating this topic relates to the secondary objective of this project, which is highlighting unique aspects of the Crabapple Creek Watershed Management Plan associated with the tourism-based resort nature of Whistler. These two phases of literature review provided a framework for guiding the case study of the Crabapple Creek Watershed Management Plan that ensued.

3.2 THE CRABAPPLE CREEK WATERSHED CASE STUDY

Using the basic principles and pertinent approaches to integrated watershed management planning as a foundation, this research then conducted a case study of the Crabapple Creek watershed management planning process. The details of this method are outlined in the following sections of this chapter.

3.2.1 USEFULNESS OF A CASE STUDY APPROACH

This project utilises a single case study to explore and apply recent directions in watershed management planning to a specific context. Case studies are a fundamental form of social science research and are especially useful when the experience under investigation is not easily distinguishable from its context (Yin 1993). The Crabapple Creek watershed management planning experience cannot be subjected to meaningful analysis without an understanding of the broader context of relevant issues in watershed management planning, and the unique character of the Resort Municipality of Whistler.

Both qualitative and quantitative forms of data collection are valid for case study research (Yin 1993). Given the nature of this study, while including some use of quantitative data (e.g. hydrologic assessments), it is based considerably on qualitative research. It is therefore subject to potential methodological problems typically associated with qualitative case study research such as poor representation and overgeneralization (Epstein Jayaratne and Stewart 1991).

As the project coordinator for the Crabapple Creek Watershed Management Plan, I was a direct participant-observer in this research process. As such, I was able to contribute in unique ways to the development and analysis of the case study. Simultaneously, my direct participation introduced some inherent challenges. Maintaining impartiality and recognising my position as an "outsider" to the Crabapple Creek watershed stakeholder community were two such challenges. I needed to continually ensure that I did not influence stakeholder opinions with regards to issues such as community watershed values and their vision for the future of the watershed. Despite information that I had gained from the literature and the specific data pertaining to Crabapple Creek, I came to realise that other valuable knowledge to be gained about the past, present and future of the watershed – knowledge crucial to the development of the watershed management plan – lay with the people who lived there.

3.2.2 COLLECTING AND ASSESSING BIOPHYSICAL INFORMATION

Mapping and Identification of Watershed Boundary

Before developing context specific management strategies and recommendations, it was necessary to gain an understanding of the condition of the Crabapple Creek watershed. Prior even to this, however, an identification of watershed boundaries was needed to clarify the physical scope of this project. A challenge was met herein, as existing maps of the Crabapple Creek watershed were found to be incomplete or inadequate. Municipal orthophotos and base mapping did not fully cover the upper portion of the watershed, whereas maps from other sources (i.e. several local consulting firms) often did not illustrate the lower basin. A compilation of mapping from various sources led to the development of several base maps of the Crabapple Creek watershed. Once these base maps were completed, the Crabapple Creek watershed boundary was delineated according to natural topography and drainage alterations related to urban, tourism and recreational facility development.

Collection of New Information

New information about certain physical and ecological characteristics of the Crabapple Creek watershed was gathered to help determine critical watershed conditions and issues. Several reaches of Crabapple Creek were surveyed to collect relevant information about stream flow, substrate, and habitat issues. In addition, primary research was conducted to ascertain the total impervious area of the Crabapple Creek watershed.

Assessment of New and Existing Information

The assembled biophysical information was evaluated to achieve an understanding of various conditions and trends within the Crabapple Creek watershed. Key indicators of watershed health, as determined largely by information found in the literature review, were assessed to ascertain biophysical conditions within the Crabapple Creek watershed. The conditions of these key indicators for Crabapple Creek, as well as other significant biophysical findings, helped to determine issues of priority for management plan objectives and recommendations.

3.2.3 ENGAGING WATERSHED STAKEHOLDERS

Identifying and Assembling Key Stakeholders

Information gained through the literature review emphasises the critical importance of stakeholder involvement in integrated watershed management planning initiatives. This research provided the rationale for engaging Crabapple Creek watershed stakeholders in the management planning initiative. Existing key land users and decision makers within the Crabapple Creek watershed were identified and approached in May 1999. These key watershed stakeholders were asked to participate in the development of the Crabapple Creek Watershed Management Plan. Of the key stakeholders approached, all agreed to take part in the planning process and committed to long term involvement as might be required in the development and implementation stages. These key stakeholders included representatives from the following groups: the Resort Municipality of Whistler (RMOW) Parks and

Recreation Department, Planning Department and Public Works Department; the Whistler Golf Course; and Whistler/Blackcomb ski area.

As expressed in the literature reviewed, the involvement of all watershed stakeholders, key and secondary, in the planning and development stages of watershed management initiatives is beneficial. For this reason, secondary watershed stakeholders were also identified and asked to participate in the development process of the Crabapple Creek Watershed Management Plan. Various representatives from the Whistler Fisheries Stewardship Group (WFSG), the Lil'wat Nation, and the British Columbia Ministry of Environment, Lands and Parks participation in developing the management plan. The Squamish Nation, approached along with the above-mentioned secondary stakeholders, did not reply to several invitations to participate in the development process.

Informing the Larger Watershed Community

Various efforts were made to involve residents and land users within the Crabapple Creek watershed who were not tied to any of the key stakeholder groups. A brochure was designed to provide these secondary watershed stakeholders with general information about the Crabapple Creek watershed and related issues and initiatives. The brochure outlined the development of the Crabapple Creek Watershed Management Plan and encouraged residents to contact the project Coordinator with comments or questions. Over one thousand brochures were delivered to the homes of watershed residents and to other land users within the watershed. The delivery of these brochures resulted only in one inquisitive phone call to the Coordinator. This lack of response by watershed residents is discussed in more depth in Chapter Five.

Local newspapers were provided with copies of the brochure and additional information regarding the development of the Crabapple Creek Watershed Management Plan. Both *The Pique* and *The Question* featured articles about the Crabapple Creek Watershed Management Plan in early July 1999. This communication through the local media was aimed at soliciting involvement from community watershed members. No inquiries to the

project Coordinator by community members resulted directly from this media coverage. However, casual dialogue between the project Coordinator and community members throughout the summer and fall of 1999 revealed that residents were made aware of the management planning initiative for Crabapple Creek due to the newspaper articles.

3.2.4 IDENTIFYING CRITICAL WATERSHED ISSUES

Key Stakeholder Questionnaire

In June 1999, a questionnaire was distributed to various key and secondary watershed stakeholders (**Appendix A**). The questionnaire was open ended and consisted of seven broad questions dealing with perceived watershed assets, watershed concerns, and respondents' willingness to commit to ongoing watershed management initiatives. The purpose of the questionnaire was to collect stakeholder views on critical watershed issues, problems, and potential solutions. The responses to this questionnaire contributed to developing the management strategies of the Crabapple Creek Watershed Management Plan.

3.2.5 DEVELOPING AND REFINING THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

A draft of the Crabapple Creek Watershed Management Plan was developed by the project Coordinator. It was based on information uncovered in the literature review, the assessed biophysical conditions and trends of the Crabapple Creek watershed, and the questionnaire responses provided by key stakeholders.

Draft Review by Watershed Stakeholders

Once a draft of the Crabapple Creek Watershed Management Plan was developed, it was circulated among watershed stakeholders for review and input. The draft review process was ongoing and iterative in nature. It occurred from July 1999 to January 2000.

Eleven representatives from three key stakeholder groups, the RMOW, the Whistler Golf Course, and Whistler/Blackcomb, reviewed each version of the draft. In total, the draft was passed through five rounds of review, with each assessment accompanied by a meeting with key representatives from the RMOW Parks and Recreation Department, Planning Department and Public Works Department. Other representatives from the WFSG were present at several of these meetings. Due to time and resource constraints, dialogue with other key representatives from the Whistler Golf Course and Whistler/Blackcomb was usually conducted over the telephone with the project Coordinator. In some cases these representatives also provided written feedback on the plan's content.

Other watershed stakeholders also participated in reviewing and revising drafts of the Crabapple Creek Watershed Management Plan. These stakeholders included representatives from the WFSG (which included representatives from the Whistler Rotary Club and the Whistler Angling Club), the Association of Whistler Area Residents for the Environment (AWARE), and the Mount Currie Indian Band (Lil'wat Nation). In addition, one watershed resident with no affiliations to any of the above mentioned groups also participated in reviewing drafts of the Crabapple Creek Watershed Management Plan.

Draft Review by External Authorities

Various experts in the fields of resource management, hydrology, and watershed assessment, management and restoration also reviewed drafts of the Crabapple Creek Watershed Management Plan. These experts included an aquatic ecologist, an independent environmental policy developer for the RMOW, a stream and restoration hydrologist, a hydrologic engineering consultant, and local environmental resource consultants. The purpose of seeking input from these experienced and knowledgeable individuals was to help ensure the technical and strategic soundness of the proposed management plan for the Crabapple Creek watershed.

Final Review

The final draft of the Crabapple Creek Watershed Management Plan was completed in January 2000. A final review of the plan is scheduled to occur during spring 2000. The draft will be reviewed by various key stakeholders including: senior RMOW staff (Parks and Recreation Department, Planning Department, and Public Works Department); the Mountain Planning and Environmental Resource Manager for Whistler/Blackcomb; the Superintendent for the Whistler Golf Course; and the British Columbia Ministry of Environment, Lands and Parks Stewardship Advisor for Whistler. Various watershed residents will also review the draft at this time, including members of several Strata Councils located within the watershed.

The final draft of the Crabapple Creek Watershed Management Plan was also made available for public scrutiny at the RMOW Municipal Hall until the document is submitted to RMOW Council for its approval as a guiding policy document for the Crabapple Creek watershed. Submission to RMOW Council is planned for May 2000.

CHAPTER FOUR
CASE STUDY – THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

This chapter provides general information about Whistler, British Columbia, then more specifically discusses the community's recent movement towards environmental sustainability. Background information about the Crabapple Creek watershed is presented, including a range of important biophysical conditions and a summary of watershed stakeholders. Most significantly, this chapter presents the content of the Crabapple Creek Watershed Management Plan, detailing specific Objectives, Recommendations, and Guidelines for restoring and maintaining ecological watershed health.

4.1 WHISTLER: MOVING TOWARDS ENVIRONMENTAL SUSTAINABILITY

The Resort Municipality of Whistler, located approximately 120km north of Vancouver in the Coast Mountain Range, is home to a year round internationally acclaimed mountain resort community. First established as an integrated planned resort in 1975, Whistler Village and surrounding municipal developments now serve as home to a permanent population of approximately 9600 that has doubled since 1991. The area receives over 2 million visitors per year (Tourism Whistler 2000). Whistler Mountain and Blackcomb Mountain provide the venue for a world class ski area, named premier North American ski resort numerous times since 1992 (Whistler Resort Association 1999).

4.1.1 GROWTH MANAGEMENT IN WHISTLER

Prior to the development of growth management policies in the 1980s, the principal aim guiding development in Whistler was to achieve a level of development which would ensure a position among the leaders in the international ski resort destination marketplace. However, as the resident and visitor populations continued to increase and as development sprawled further throughout the valley, Whistler recognised the need to impose a limit to growth. It was felt that a limit to growth, as well as guidelines to types of growth, were

needed to ensure the continued high quality of the resort environment that attracts those residents and visitors. In 1982, the RMOW restricted the amount of development to a ceiling of 45, 000 bed units as part of a growth management strategy. This development capacity was in raised 1989 and currently sits at above 52,000 bed units (Resort Municipality of Whistler 1996). In keeping with growth management strategies employed to maintain a high quality of service infrastructure and natural environment, the RMOW has been conducting an intensive annual monitoring program since 1994 to measure and help control growth patterns and impacts (Resort Municipality of Whistler 1996).

4.1.2 THE VISION: WHISTLER 2002

In 1997, the RMOW embarked on a visioning process to identify community values and priorities for the coming 5 years. The overall aim of the visioning process was to prepare a common vision and directions for guiding the resort community into the 21st Century. The Vision for Whistler primarily identified four specific priorities, including:

- Building a Stronger Resort Community;
- Enhancing the Whistler Experience;
- Moving Towards Environmental Sustainability; and
- Achieving Financial Sustainability.

This range of priorities was discussed amongst the community through means such as Town Hall Meetings and an extensive survey workbook entitled *Whistler 2002: Charting A Course For The Future*. During the analysis of *Whistler 2002*, it was clear that the value of the natural environment was emphasised by respondents. In effect, 100 percent of workbook respondents supported or strongly supported the priority "Moving Towards Environmental Sustainability". This result highlighted the idea that demonstrating leading environmental stewardship is fundamental to Whistler's success as a premier mountain resort community (Waldron 1999). Whistler depends on maintaining a high quality of visitor experience as well as a high quality of life for its residents. The provision of first rate accommodation, services, facilities and development as well as a high degree of environmental protection are necessary to maintain the quality of the Whistler experience.

4.1.3 THE *WHISTLER ENVIRONMENTAL STRATEGY*

In response to the overwhelming support for moving towards environmental sustainability, the *Whistler Environmental Strategy* development process was initiated to address this movement in a comprehensive manner. The development of the *Whistler Environmental Strategy* has been underway since the summer of 1998 and continues. The proposed strategy currently exists as a Discussion Paper for public review and input. The *Whistler Environmental Strategy* addresses many of the major environmental challenges facing Whistler, ranging from critical habitat and ecologically sensitive area protection to environmentally responsible energy, wastewater and transportation management. Beginning with key elements of environmental stewardship such as Values and Guiding Principles, the *Whistler Environmental Strategy* provides a road map for moving towards environmental sustainability, detailing specific Strategic Goals, Targets and Tasks.

Listed as one of the Tasks of the *Whistler Environmental Strategy* under the heading "Establishing and Maintaining a Protected Areas Network Within the RMOW" is the development of watershed management plans for 12 Whistler waterways, including Crabapple Creek. The fulfilment of this Task is aimed at implementing ecosystem-based management of various areas, thereby helping to maintain the ecological integrity of these systems (Waldron 1999). The development of the Crabapple Creek Watershed Management Plan is the first of these watershed management plans to be completed and will serve as a template for future watershed management planning initiatives in Whistler. The Crabapple Creek Watershed Management Plan is also the first of all Tasks listed in the *Whistler Environmental Strategy* as a whole to be completed, pioneering Whistler's planned movement towards environmental sustainability.

4.2 THE CRABAPPLE CREEK WATERSHED – BACKGROUND

This section first provides a general overview of the condition of the Crabapple Creek watershed. A more detailed overview is then presented, providing significant information

regarding some key indicators of watershed health for Crabapple Creek. A summary of Crabapple Creek watershed stakeholders is also presented.

4.2.1 GENERAL WATERSHED OVERVIEW

Whistler's Crabapple Creek watershed (**Figure 1**), also known as Archibald Creek, drains an area of approximately 483 ha (4.83 km^2), from its headwaters on Whistler Mountain, through the neighbourhoods of Sunridge Place and Brio, through the Whistler Golf Course to the confluence where it joins the River of Golden Dreams near Lorimer Road.

Crabapple Creek, like many other urban watersheds, has been experiencing the impacts of development. Various streams within this watershed have had their riparian vegetation removed, been put through culverts, and been channelised into ditches. Some of the land within the watershed has been paved for roads and housing developments, but the total impervious area is reasonably low at less than 10%.

Extensive logging in the 1950s and 1960s, along with the more recent development of a world class ski area, have disturbed the headwaters of Crabapple Creek. Disturbances to the watershed on Whistler Mountain related to Whistler/Blackcomb ski area include the removal of riparian vegetation, culvert crossings beneath roads and ski runs, the development of several buildings, a gondola and chairlifts, and the use of water from Crabapple Creek and Alder Creek (a main tributary) for drinking water and snowmaking activities.

The main stem of Crabapple Creek currently flows along the Whistler Golf Course, a flat valley area that was historically the site of a large natural wetland through which Crabapple Creek meandered freely. To accommodate the construction of the golf course, the main stem of Crabapple Creek was completely diverted to the west side of its floodplain, channelised and stabilised with riprap. Despite some instream restoration work, the channel remains largely unnatural, with few pool/riffle steps and even fewer meanders. Concerns exist about the reduced channel drainage capacity of Crabapple Creek.

The Crabapple Creek watershed is relatively close to its own build-out. 90% of development slated for the watershed is already complete. Rationales for future construction activities within the watershed include the completion of planned development, maintenance and repair of existing facilities (i.e. roads, trails, buildings, Whistler Golf Course, Whistler Mountain, etc.), and the potential rezoning of already developed lands.

The various development activities mentioned above can result in effects such as streambank erosion, water sedimentation, and increased runoff flows, all of which reduce the quality of instream habitat for fish and invertebrates (Schreier et al. 1997; Zandbergen 1998). Despite these factors, the lower reaches of Crabapple Creek currently provide some of the best spawning habitat for rainbow trout in the Whistler Valley (Thomson 1996). Although the watershed has undergone some significant changes to its natural character, the health of Crabapple Creek is relatively intact and it is the intention of this watershed management plan to help ensure the continued vitality of this important local ecosystem.

4.2.2 DETAILED WATERSHED OVERVIEW

Regional Climate Characteristics

Whistler's Crabapple Creek watershed is located in the Pacific Range of the Coast Mountains and comprises part of both the Coastal Western Hemlock and Mountain Hemlock Biogeoclimatic Zones. Areas at valley elevation experience relatively dry, warm summers (lows of 6 to 8 and highs of 19 to 23 degrees Celsius) and winters with moderate temperatures (lows of –8 to –5 and highs of –1 to 3 degrees Celsius). Coldest temperatures are typically in January, with the warmest temperatures occurring in July and August. Average valley precipitation is 1198mm per year, with peak snowpack occurring in February and March. Average annual snowfall at Whistler Mountain peak is 914cm (Resort Municipality of Whistler 1997).

Geomorphologic Background

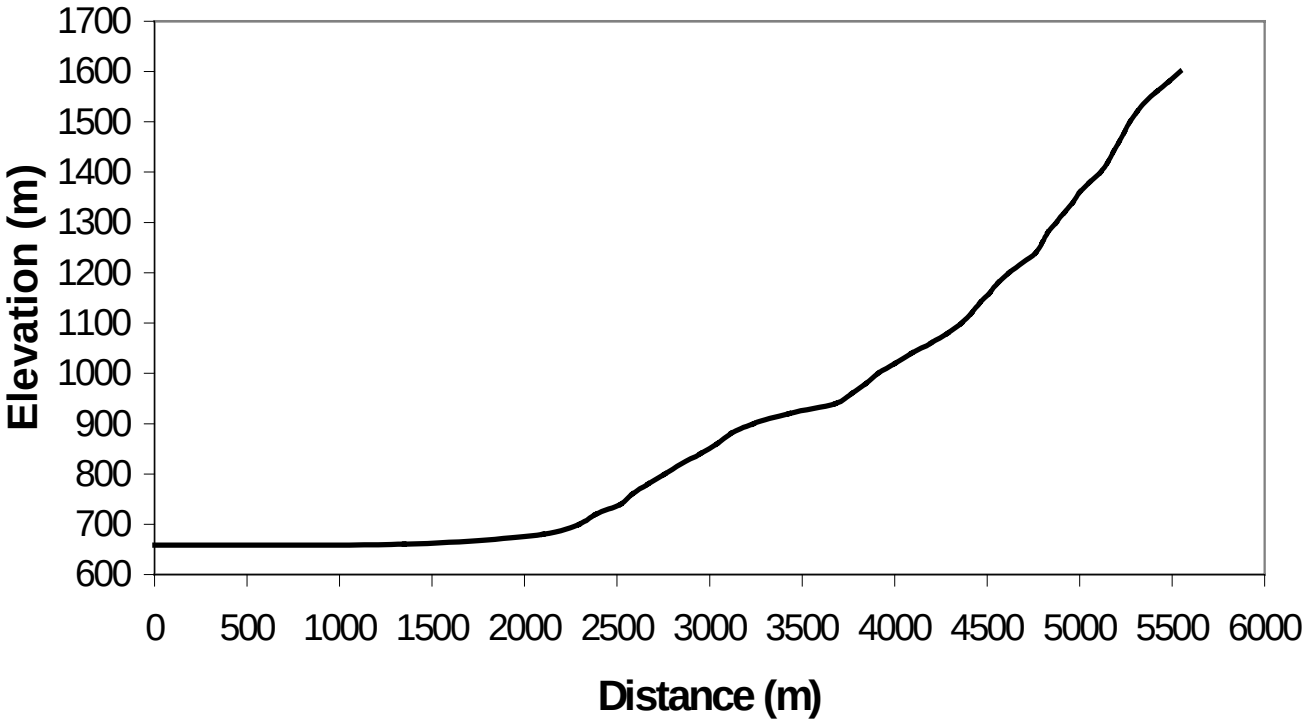
The Crabapple Creek watershed area is comprised of Gambier Group stratified rocks and Slollicum Schist metamorphic assemblage. Soils derived from the Gambier and Slollicum metamorphic assemblages are expected to be relatively fine (EBA Engineering Consultants and British Columbia Ministry of Energy, Mines and Petroleum Resources 1992).

In the upper basin, Crabapple Creek and its tributaries descend through relatively recent geologic substrate, as indicated by the predominance of large boulders and steep channel descents. In the lower basin, the Crabapple Creek watershed is primarily characterised by a fluvial history. The watershed area downstream, or north, of Highway 99 to the mouth, now mainly occupied by the Whistler Golf Course, was at one time a glacial lake, and more recently the site of a large natural wetland (Williamson 1999).

Hydrologic Characteristics

The Crabapple Creek headwaters originate on mid-Whistler Mountain, descending from approximately 1600m to 658m elevation over a 5600m distance for a total slope of 17% (**Figure 2**). With most of the elevation occurring upstream, or south, of Highway 99, this high-energy system commonly carries sediment and woody debris.

Figure 2 Crabapple Creek elevation profile



The upper basin of the watershed (**Figure 3**) is characterised primarily by the gully headwater system of Crabapple Creek and its tributaries, while the lower basin reaches (**Figure 4**) have much gentler gradients of generally less than 2%. The low-lying main stem of Crabapple Creek historically served peak flows from Whistler Mountain tributaries with the natural retention storage of a marshy wetland. This lowland marsh also served to settle out silt and debris during the freshet period. The bankfull discharge of Crabapple Creek near the confluence of the River of Golden Dreams is estimated at approximately $1.05 m^3/sec$.

Figure 3 Crabapple Creek upper basin on Whistler Mountain

Figure 4 Crabapple Creek lower basin at north end of Whistler Golf Course

Bed Paving Material

A recent survey of two upper basin reaches reveals a general substrate composition of the following:

- large boulders > 25cm in diameter (approximately 25%);

- cobble 5cm < 25cm (approximately 55%);
- gravel 2mm < 5cm (approximately 10%); and
- fines/sand < 2mm (approximately 10%).

Past and recent surveys reveal the substrate of lower basin reaches to comprise mainly fines and gravel with some cobble and few boulders (Krzesinska 1995; Neuman and Fox 1980). A 1996 survey indicates increased fines from previous assessment in several of these reaches with relatively lower gradients (Krzesinska 1996).

Water Quality

Water quality monitoring has been conducted on Crabapple Creek annually since 1995 and results have generally indicated good water quality. However, the inconsistency of sampling and limited baseline data are not sufficient for reliable conclusions.

Dissolved Oxygen

The amount of dissolved oxygen in stream water affects the kinds of life found there. Depleted oxygen levels can create adverse conditions for many aquatic organisms including fish. Temperature, flow levels, velocity, organic wastes and stream complexity are some important factors affecting dissolved oxygen levels (Taccogna and Munro 1995; Yates 1988).

Dissolved oxygen levels in lower Crabapple Creek have been measured at moderate levels of between 65% and 85% saturation. A very healthy stream would normally have a saturation level of between 90% and 110%. Some possible reasons for a lower saturation level include slower flowing water, little instream complexity, high concentration of organic wastes such as fertilisers, high concentrations of algae, and low water temperatures (Taccogna and Munro 1995; Yates 1988). A more representative measure of dissolved oxygen levels would include a measurement of absolute concentration in addition to percent saturation.

pH

pH is the relative acidity of water as ranked on a logarithmic scale of 0 – 14, 0 being strongly acidic and 14 being strongly basic. Water with pH of 6.5 – 8.5 is the normal range for supporting diverse stream life (Taccogna and Munro 1995; Yates 1988).

The pH of Crabapple Creek's lower reaches has been measured at ranging between 5.0 and 8.3. Some possible reasons for low pH include heavy rainfall, snow melt, road runoff and drainage from coniferous forest areas (Taccogna and Munro 1995).

Temperature

Temperature is a key physical parameter in aquatic ecosystems and is influenced by weather, removal of riparian vegetation, turbidity from sediment transport, storm water inputs, groundwater inputs and industrial discharges. If water temperatures exceed the normal range of tolerance for some aquatic species, they may become stressed and die (Taccogna and Munro 1995; Yates 1988).

The temperature of Crabapple Creek's lower reaches, sampled normally in the summer months, has ranged from 7 to 13 degrees Celsius. These measurements are within the healthy range for accommodating salmonid and trout species, which prefer cooler stream water, such as 5 – 13 degrees Celsius (Taccogna and Munro 1995).

Turbidity

Turbidity is a measure of cloudiness caused by sediment, pollution, or microscopic organisms in water. Sedimentation, often caused by streambank erosion, can result in significant habitat degradation for fish and aquatic life. Suspended particles restrict light penetration in the water, affecting algal growth and oxygen production. Sediment can clog breathing structures of fish and benthic invertebrates and can settle between cobble, smothering fish eggs (Taccogna and Munro 1995; Yates 1988).

Turbidity in Crabapple Creek has only been recorded for 1997, and results for that sampling indicate a relatively healthy measurement. As the indicator has only been sampled and

recorded once in recent years, these data insufficiently indicate accurate baseline conditions. With the anecdotally observed excess sedimentation levels in the lower reaches of Crabapple Creek, it is recommended that this indicator be monitored more stringently and with a consistent measurement unit such as Total Suspended Solids (TSS) or NTU.

Riparian Land Use and Conditions

Riparian, or streamside, conditions can greatly affect the health of a stream system (Malanson 1993; Schreier et al. 1997; Taccogna and Munro 1995; Yates 1988; Zandbergen 1998). As noted above in the literature review, the recognition of riparian influence on stream health is crucial in any watershed management initiative.

Currently there is no accurate measurement of percent intact riparian area for the Crabapple Creek watershed. Riparian land use along Crabapple Creek and its tributaries in the upper basin (south of Highway 99) is currently characterised primarily by Whistler Mountain ski area and by the residential developments of Sunridge Plateau and Brio. During the 1950s and 1960s, the Whistler Valley corridor was heavily logged and this undoubtedly affected the age, structure, density and diversity of riparian forest surrounding Crabapple Creek and its tributaries. The natural riparian zone has more recently been reduced along various upper reaches by the creation of ski runs and maintenance roads and trails on Whistler Mountain. The overall riparian integrity along streams in this portion appears generally intact. As Crabapple Creek flows north towards Highway 99, the natural riparian zone has been decreased significantly or eliminated in places, especially throughout Brio, by the residential road and housing network.

Riparian land use along Crabapple Creek in the lower reaches (north of Highway 99) is characterised primarily by Whistler Golf Course to the east and by the Valley Trail, Blueberry Hill and Whistler Cay Estates residential developments to the west. The existing riparian zone along this lower portion is minimal in width, since much of the historic vegetation has been removed for development of the Whistler Golf Course, housing, paved trails and residential road networks. Closer to the mouth of Crabapple Creek, past the

Whistler Golf Course, the riparian zone is somewhat more intact but is still insufficient for proper functioning conditions to be achieved. Some riparian vegetation restoration has been carried out along the lower reaches of Crabapple Creek, specifically towards the mouth by Whistler Cay Estates and Our Lady of the Mountains Catholic Church.

Common indigenous tree species found within the Crabapple Creek watershed include:

- *Tsuga heterophylla* (western hemlock);
- *Tsuga mertensiana* (mountain hemlock);
- *Psuedotsuga menziesii ssp. menziesii* (Douglas-fir);
- *Thuja plicata* (western redcedar*);*
- *Alnus rubra* (red alder);
- *Abies amabilis* (Amabilis fir);
- *Populus balsamifera ssp. Trichocarpa* (black cottonwood); and
- *Malus fusca* (Pacific crab apple).

Common indigenous shrub species found within the Crabapple Creek watershed include:

- *Gaultheria shallon* (salal);
- *Vaccinium parvifolium* (red huckleberry*);*
- *Sambucus racemosa ssp. pubens* (red elderberry);
- *Symphoricarpos albus* (common snowberry*);*
- *Sorbus sitchensis* (Sitka mountain-ash);
- *Crataegus douglasii* (black hawthorn);
- *Acer glabrum* (Douglas maple);
- *Physocarpus capitatis* (Pacific ninebark);
- *Rubus parviflorus* (thimbleberry);
- *Oplopanax horridus* (devil's club);
- *Cornus stolonifera* (red-osier dogwood;
- *Rosa nutkana* (nootka rose);
- *Rosa gymnocarpa* (dwarf rose);
- *Vaccinium alaskaense* (Alaskan blueberry); and

- *Vaccinium ovalifolium* (oval-leaved blueberry).

This listing of common riparian species found in the Crabapple Creek watershed may be used as a partial guide to riparian restoration projects.

Fish

Fish, especially salmonids, serve as a useful indicator of stream and watershed integrity (Taccogna and Munro 1995; Yates 1988). Current fish populations of significance in Crabapple Creek include rainbow trout (Onchorhyncus mykiss) and kokanee salmon (Onchorhyncus nerka). The main stem of Crabapple Creek, north of Highway 99, is the most important spawning and rearing channel for Alta and Green Lake fish populations (Thomson 1996). Fish habitat is limited in the system due to an impassable culvert at the crossing beneath Highway 99.

Fish trapping has been conducted sporadically since the late 1970s during the late spring through early fall in the Whistler Valley. Results indicate that Crabapple Creek is the main spawning creek for rainbow trout. Rainbow trout spawn in the lower reaches of Crabapple Creek in the late spring. Fry emerge from the gravel around late summer and spend several years rearing in deep pools in Crabapple Creek and the River of Golden Dreams. During their life stages, rainbow trout may also spend time in Alta and Green Lakes.

Of all the Whistler Valley systems sampled by the WFSG since 1995, Crabapple Creek has consistently had the highest recorded number of rainbow trout. Fish monitoring on Crabapple Creek in 1995 conducted by the WFSG resulted in the counting of 2095 fish, the majority being rainbow trout and the remainder kokanee salmon.

One of the main fish habitat problems in Crabapple Creek is the heavy presence of fine sediment, especially throughout the late spring and summer months. This loading limits the availability of clean spawning gravel in the lower reaches. Other habitat concerns include lack of riparian vegetation and related riparian and instream complexity, fish passage obstruction by the culvert crossing beneath Highway 99, and altered natural channel morphology in the main stem of Crabapple Creek.

Benthic Invertebrates

Benthic macroinvertebrates serve as excellent indicators of stream and watershed health. A stream with a diverse assemblage and healthy populations of invertebrates normally indicates good stream quality, whereas a stream with low benthic diversity and large populations of species more tolerant to pollution and poor conditions may indicate problems with water quality or instream habitat (Culp, Cash and Halliwell 1997; Taccogna and Munro 1995; Yates 1988).

Sampling of invertebrates in Crabapple Creek in 1997 indicated the presence of several pollution intolerant types including caddisfly larvae, mayfly larvae and stonefly nymphs. Also found were several more tolerant species including alderfly larvae, aquatic beetles, cranefly larvae, aquatic worms, and water mites. However, recent anecdotal evidence suggests that a lack of diversity and density of invertebrate life exists in the lower reaches of Crabapple Creek. More frequent sampling would help to provide a more comprehensive basis on which to assess the invertebrate situation in Crabapple Creek.

Impervious Area

Impervious area has become increasingly recognised as a significant indicator of watershed health. The total impervious area of the Crabapple Creek watershed is approximately 9.92% (43.5 ha). A large portion of the impervious area within the watershed (55%) consists of buildings and paved roads. Unpaved roads, sidewalks, trails, driveways and parking lots make up a further 34% of the total impervious area of the watershed (**Table 1**).

Table 1 Impervious area of the Crabapple Creek watershed

Land Use Within Watershed	Area (ha)	Impervious Factor (%)	% of Total Watershed Area
Paved Roads	12.37	100	2.8
Unpaved Roadways	5.20	100	1.19
Buildings	11.78	100	2.69
Sidewalks and Trails	4.46	100	1.02
Driveways and Parking Lots	5.30	100	1.21
Tennis Courts	0.17	100	0.04
Pools	0.05	100	0.01

Construction	0.11	100	0.03
Bare	1.03	10	0.23
Grass/Shrub/Forest	395.35	1	90.2
Water	2.49	0	0.57
Total	438.3		100
Total Watershed Area (ha)	438.3		
TOTAL % IMPERVIOUS AREA OF WATERSHED	**9.92**		

(Adapted from Houston 1999)

Watershed Restoration

Limited stream restoration projects have been completed along the main stem of Crabapple Creek, north of Highway 99. Development of the Whistler Golf Course in 1981 involved the construction of several ponding areas. In part, the ponds that have been incorporated into the golf course design were intended to serve as settling basins to help relieve the creek's sediment load and to serve as detention basins to slow Crabapple Creek's rate of flow, as well as to contribute to the aesthetics of the course (Kerr Wood Leidal Associates Ltd. 1982). It has not been determined exactly how significant the effects of these ponds are, although anecdotal evidence indicates that they are trapping large quantities of fine substrate during heavy rainfall periods.

In 1990, in conjunction with the development of Blueberry Hill residential development, a significant reach of the channel was realigned to flow along the west side of Whistler Golf Course. The channel was stabilised with riprap and several pool/riffle steps were created through the construction of large rock weirs. Riparian replanting was conducted along the east side of the channel on the golf course. It should be noted here that instream engineering and restoration connected with golf course and Blueberry Hill development on the mainstem of Crabapple Creek was performed, as required by the RMOW, under the direction of a fisheries biologist (Kerr Wood Leidal Associates Ltd. 1990).

In 1996, several instream habitat enhancement projects were completed on the lower reaches of Crabapple Creek, from the crossing beneath Crabapple Drive to the confluence at River of Golden Dreams. Projects aimed at enhancing spawning and rearing habitat included the deposition of spawning cobble, boulder placements, and placement of a root wad and several log revetments. Streamside planting was completed along this reach the following spring (Beresford 1999).

4.2.3 WATERSHED STAKEHOLDERS

The involvement of key stakeholder groups and individuals shaped and facilitated the development of the CCWMP. The primary stakeholders, meaning here those who make most of the decisions and those most affected by these decisions, within the Crabapple Creek watershed included:

- watershed residents and landowners;
- visitors and tourists;
- Whistler Golf Course (Tourism Whistler);
- Whistler/Blackcomb (Intrawest); and
- the Resort Municipality of Whistler
    - Parks and Recreation Department
    - Planning Department
    - Public Works Department (Engineering).

Secondary stakeholders within the Crabapple Creek watershed currently include:

- WFSG (a collection of partners representing various local groups including: Whistler Golf Course, Whistler/Blackcomb, RMOW, Whistler Rotary Club, Whistler Angling Club, Chateau Whistler Golf Course/Chateau Whistler Resort, Nicklaus North Golf Course, and AWARE);
- British Columbia Ministry of Environment, Lands and Parks (BC MELP);
- Mount Currie Indian Band (Lil'wat Nation); and
- Squamish Nation.

Largely the result of input from these stakeholders, the management plan was designed to achieve their specific vision for Crabapple Creek. As the plan moves into stages of implementation, it is these same stakeholders who will help accomplish the Recommendations, monitor progress towards Objectives, and strive to achieve and maintain the Vision for Crabapple Creek.

The future success of this watershed management plan will depend largely on informed municipal and public support, developed through inclusive planning processes, education and information programs. An increased awareness of watershed values, achieved by stakeholder participation in, and distributed information about, the development of the Crabapple Creek Watershed Management Plan will help maintain, restore and enhance the overall health of the Crabapple Creek watershed.

4.3 THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The Crabapple Creek Watershed Management Plan (CCWMP) is a document that will guide decisions and activities towards protecting and restoring the ecological integrity of Crabapple Creek while accommodating human uses. As part of Whistler's comprehensive movement towards environmental sustainability, this plan lays out specific Objectives, Recommendations and Guidelines for maintaining and improving watershed health.

The CCWMP takes an integrated approach, recognising that land use decisions and activities have associated impacts on riparian and aquatic environments. The plan addresses various key watershed issues, ranging from instream fish habitat concerns such as spawning and rearing areas and streambank erosion, to riparian protection, stormwater management, flood control and public education and involvement.

The CCWMP is meant to be a living, working document, adaptable to changes in future conditions, information, and community values. Always, however, the spirit of the plan targets the ecological integrity of Crabapple Creek as its ultimate objective.

4.3.1 PURPOSE OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The development of this plan was initiated by the *Whistler Environmental Strategy*. The specific purposes of the CCWMP are to:

- guide watershed decisions and activities in the best interests of ecological stream, wetland and riparian health;
- protect the health of Crabapple Creek through watershed specific Recommendations and Guidelines;
- synthesise ecological and social elements to enhance stewardship within the watershed;
- raise resident and visitor awareness of resort community watershed issues; and
- act as a model for guiding the development of future Whistler watershed management plans.

4.3.2 JURISDICTION OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The Crabapple Creek watershed makes its home within the boundaries of the Resort Municipality of Whistler. Currently, the lower portions of the watershed are publicly and privately owned, while the upper portion of the watershed exists on Crown land and is currently leased to Intrawest for the development and operation of Whistler/Blackcomb ski area. Historically, the Crabapple Creek watershed lies within the traditional territory of both the Squamish and Lil'wat Nations. Once approved by the RMOW Council as a municipal document, activities and decisions within the Crabapple Creek watershed area will be guided by the CCWMP. Implementation of the CCWMP may lead to the further development of regulatory components by the RMOW (e.g. stream and riparian protection bylaws). The CCWMP will be implemented in conjunction with and within the context of other pertinent local, regional, provincial and federal policies. These regulatory elements may be implemented specifically for the Crabapple Creek watershed or they may result from the development of a comprehensive environmental bylaw initiated by the *Whistler Environmental Strategy*. Any municipal policy directives recommended by the CCWMP,

such as bylaws, site design and zoning regulations, will apply to the watershed in its entirety once approved by RMOW Council.

It is hoped that, additionally, one or several Memorandums of Understanding will be signed between key watershed stakeholders. This policy measure will further encourage strong stewardship ethics and compliance towards protecting the ecological integrity of Crabapple Creek.

4.3.3 STRUCTURE OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

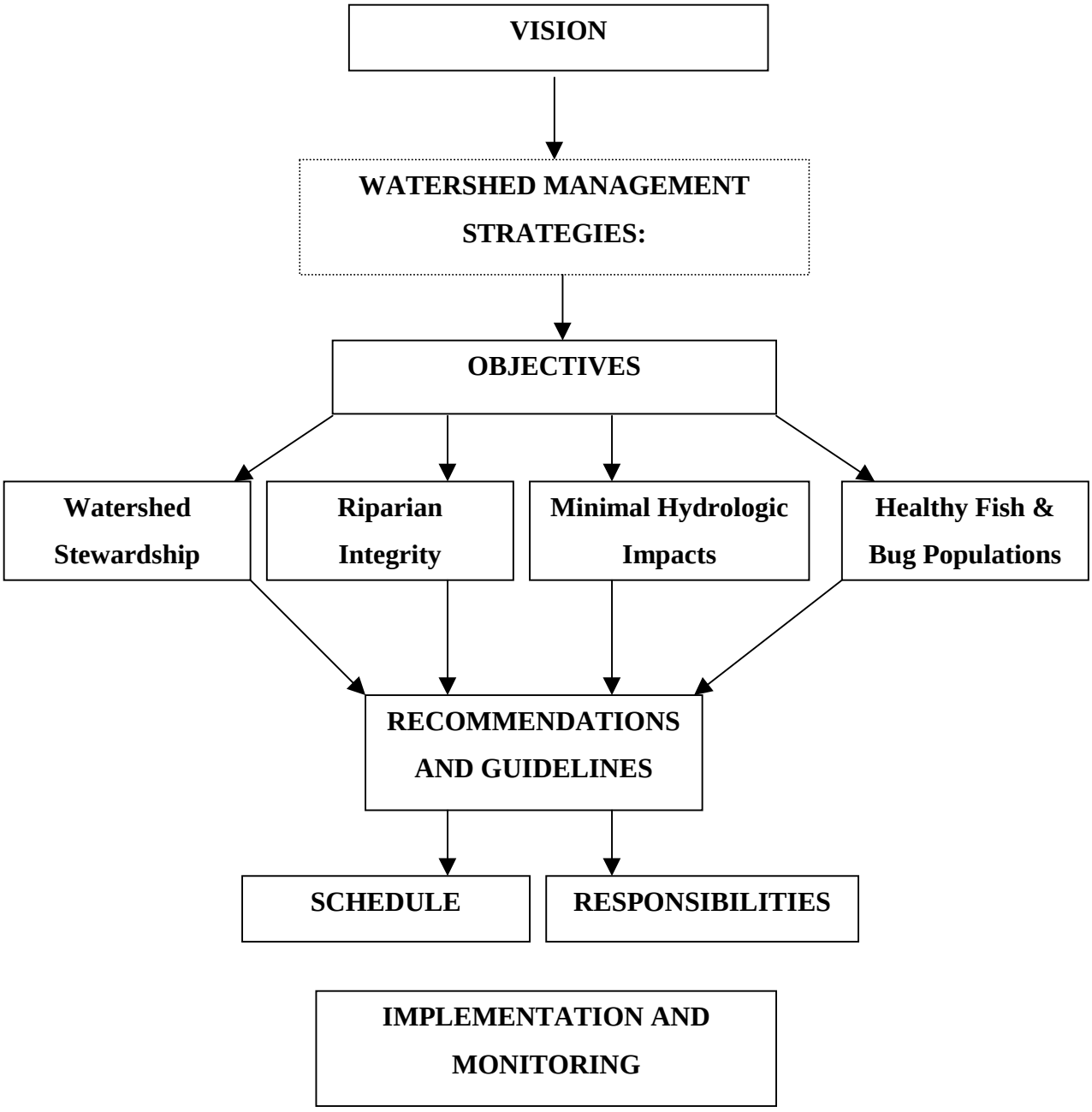
Determined by stakeholders, the stated **Vision** for the Crabapple Creek watershed signifies the overriding goal of the CCWMP. This Vision is, by nature, expansive and meant to portray the holistic desire for an ecologically healthy watershed. However, such a broad goal is admittedly difficult to achieve and even more difficult to measure progress towards. As such, it is necessary to break this Vision down into more distinct, manageable goals. These smaller goals may be considered **management strategies**, or approaches to achieving the larger watershed Vision. In the CCWMP, these management strategies are divided into three categories: **Objectives**, **Recommendations**, and **Guidelines**. The Objectives outline the more specific goals of the management plan and the Recommendations and Guidelines outline the various tasks meant to achieve these ends. Together, these management strategies work towards fulfilment of the watershed Vision.

The CCWMP outlines a multitude of opportunities for encouraging education and stewardship by watershed residents and visitors. The plan proposes the development and implementation of the ***Crabapple Creek Interpretive Strategy*** which will encourage environmental learning and stewardship while enhancing recreation opportunities within the watershed. Detailing creative interpretive initiatives as well as potential themes and messages, the *Crabapple Creek Interpretive Strategy* highlights community stewardship and restoration activities along with ecological knowledge.

The CCWMP outlines provisions for the effective **implementation** of the plan. The CCWMP proposes the creation of two key groups, the Crabapple Creek Watershed Management Committee and the Crabapple Creek Watershed Management Implementation Team, both comprised of key stakeholders and decision makers to help ensure the continued implementation and monitoring of the plan's directives.

Monitoring is a vital component in any watershed management initiative. Critical for detecting emerging concerns and measuring progress towards objectives, monitoring provides information on which to base appropriate and effective management decisions. The CCWMP proposes a broad range of monitoring indicators to detect arising problems and to help measure progress towards fulfilling the watershed Objectives.

Figure 5 Structure of the Crabapple Creek Watershed Management Plan



4.3.4 VISION FOR THE CRABAPPLE CREEK WATERSHED

Based on stakeholder input, an overriding vision for the management of the Crabapple Creek watershed was developed. This vision clearly states that Crabapple Creek will be a thriving resort community watershed that supports the sustained ecological health of its stream, wetland and riparian ecosystems, protected and restored from the negative pressures of land use while allowing for residential, commercial and recreational uses. Residents and visitors, encouraged by innovative watershed initiatives, will be stewards of this community resource in perpetuity.

4.3.5 CRABAPPLE CREEK WATERSHED MANAGEMENT STRATEGIES: OBJECTIVES, RECOMMENDATIONS AND GUIDELINES

This section details the CCWMP management strategies for Crabapple Creek, which include Objectives, Recommendations and Guidelines. These management strategies were developed utilising a combination of the following: information gained from the literature review; biophysical information specific to the Crabapple Creek watershed; and thoughts expressed by watershed stakeholders in their responses to the questionnaire (**Appendix A**).

Objectives

The Objectives of the CCWMP are intended to more definitively express the stakeholder Vision for the watershed, dividing that holistic aspiration into specific categories of watershed concerns. The Objectives for the CCWMP relate to the following four issues: awareness and stewardship; riparian areas; hydrologic conditions; and aquatic habitat. Recommendations and Guidelines are the means by which the Objectives will be met. The fulfilment of each of the four Objectives will work towards realising the holistic Vision for the watershed.

Recommendations

The Recommendations of the CCWMP are specific tasks intended to achieve each of the four Objectives. Completion of the Recommendations will help achieve each watershed Objective and, as such, will ultimately facilitate the realisation of the overall Vision. Each

Recommendation is accompanied by a schedule for completion and designated responsible organisations (**Table 2**).

Guidelines

The Guidelines of the CCWMP are similar in function to the Recommendations in that they are tasks aimed at fulfilling each of the watershed Objectives. However, whereas the Recommendations are intended as minimum necessary standards and actions for watershed protection, the Guidelines convey more ideal standards to be implemented whenever opportunities exist. Responsible parties for implementing the Guidelines are not specified here; they are meant to be applied by the appropriate decision makers wherever applicable.

4.3.5.1 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN OBJECTIVE 1: RECOMMENDATIONS AND GUIDELINES

This section states the first Objective of the CCWMP and details the Recommendations and Guidelines that will contribute to achieving this Objective. This Objective and its accompanying Recommendations and Guidelines reflect the importance placed on public education by both stakeholder questionnaire responses and the literature reviewed. Public education, as revealed by the literature, is a critical component of any effective integrated watershed management plan. The emphasis on interpretation as a means of fostering watershed education, mindfulness and stewardship reflects the potential of interpretive initiatives discussed in the literature.

Objective 1

Resort community government, residents and visitors demonstrate a high level of watershed stewardship.

Objective 1: Recommendation A

Develop and distribute an information brochure highlighting the general characteristics of the Crabapple Creek watershed, including community stewardship initiatives.

Objective 1: Recommendation B

Implement the *Crabapple Creek Interpretive Strategy* (section 4.3.6.2).

Objective 1: Recommendation C

Develop and implement both formal and informal means of communicating watershed issues to relevant employees (e.g. managers and grounds/maintenance crews) of primary watershed stakeholder groups such as Whistler/Blackcomb, the Whistler Golf Course, and the RMOW. These employees can play critical roles both in actively protecting the integrity of Crabapple Creek and in raising awareness about watershed issues among members of the community.

Objective 1: Recommendation D

Continue to highlight Crabapple Creek for education programs such as River Life, Streamkeepers and Wetland Keepers, as well as for grade school projects and field trips.

Objective 1: Recommendation E

Provide watershed residents and landowners with a guide for household watershed stewardship and tips for riparian and stream care. This guide should include information regarding potential problems to look for and who to notify in case of problems.

Objective 1: Recommendation F

Prepare and distribute an information brochure detailing the key components of the CCWMP.

Objective 1: Recommendation G

Develop a multipurpose interpretive display about Crabapple Creek for use in presentations, workshops, conferences, watershed walks, BC Rivers Day activities, and more. The display should highlight various watershed issues such as stream ecology, development history and impacts, stewardship and restoration initiatives, and the development of the CCWMP. The display might illustrate some of the themes and messages listed in the *Crabapple Creek Interpretive Strategy*. The display should be visually enjoyable and informative, including

maps, written segments, photos, and potentially a three dimensional model of the watershed area.

Objective 1: Recommendation H

Highlight Crabapple Creek watershed initiatives in annual BC Rivers Day festivities.

Objective 1: Recommendation I

Provide a continual stream of articles to community newspapers and organisations regarding Crabapple Creek watershed health and stewardship initiatives.

Objective 1: Guidelines

The following Guidelines should be considered in order to encourage watershed stewardship by resort community residents and visitors.

- Partnerships relating to watershed stewardship should be encouraged and fostered among all watershed stakeholders.
- Watershed residents should be sufficiently informed of all major watershed initiatives potentially affecting stream and riparian health (e.g. newspaper announcements).
- Stakeholder input should be gathered and meaningfully considered regarding any major watershed initiatives potentially affecting stream and riparian health.
- Further opportunities for watershed interpretation and education should continually be sought and developed.

4.3.5.2 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN OBJECTIVE 2: RECOMMENDATIONS AND GUIDELINES

This section states the second Objective of the CCWMP and details the Recommendations and Guidelines that will contribute to achieving this Objective. This Objective and its accompanying Recommendations and Guidelines reflect both stakeholder questionnaire responses and the assertion within the literature that riparian integrity is essential to

maintaining ecological watershed health. Riparian areas perform numerous functions that are vital to the properly functioning condition of channel hydrology and aquatic habitat. The literature maintains that the restoration and protection of riparian areas are critical biophysical issues that should be significantly represented in any integrated watershed management plan.

Objective 2

Riparian areas along Crabapple Creek and its tributaries are healthy, restored and protected.

Objective 2: Recommendation A

Identify and classify according to habitat value Crabapple Creek main stem and all non-intermittent tributaries to be included in riparian protection and restoration initiatives.

Objective 2: Recommendation B

Complete municipal mapping inventory with matching 1:2000 orthophoto maps for the upper Crabapple Creek basin on Whistler Mountain.

Objective 2: Recommendation C

Establish and implement protective riparian setback zones for Crabapple Creek and its tributaries. The riparian setback zones should be applied to undeveloped streamside areas and to already developed streamside areas proposed for rezoning or any type of additional or redevelopment. The width of riparian setbacks for Crabapple Creek and its tributaries has been determined by incorporating key stakeholder input with the technical recommendations of relevant literature. The minimum riparian setback zone for Crabapple Creek and all tributaries should be 15m from top of bank (top of bank to be determined as outlined in the *Land Development Guidelines for the Protection of Aquatic Habitat,* Chillibeck, Chislett and Norris 1993 or by evolving representative definitions). This Additional protective riparian setback zones may be based upon the Streamside Protection Area (SPA) classification determined by the Streamside Protection Policy Directives pilot project for Crabapple Creek.

Setbacks for low density/residential/recreational development should be as follows:

- SPA 1: full riparian area protection – minimum 40m setback;
- SPA 2: minimum 30m setback;
- SPA 3: minimum 15m setback; and
- SPA 4: minimum 15m setback.

Setbacks for high density/commercial/industrial development should be as follows:

- SPA 1: full riparian area protection – minimum 50m setback;
- SPA 2: minimum 40m setback;
- SPA 3: minimum 30m setback; and
- SPA 4: minimum 20m setback.

During the completion of the Streamside Protection Policy Directives pilot project in 1999, Cascade Environmental Resource Group performed a mapping exercise identifying the *top of bank* along Crabapple Creek. This mapping will likely prove very useful in implementing protective riparian setbacks. Riparian area setbacks should be implemented through zoning bylaws, amendments to the Official Community Plan, or other Municipal Act Bill 26 powers.

Objective 2: Recommendation D

Where development of riparian areas is unavoidable, require that compensation (i.e. restoration of other riparian areas) be provided within the watershed at a minimum 2:1 ratio. This compensation requirement should be implemented through supporting bylaws, amendments to the Official Community Plan, or other Municipal Act Bill 26 powers. Where riparian areas are developed, interpretive signage should be placed explaining that compensation is being provided elsewhere within the watershed. Related signs should also be placed at compensation sites.

Objective 2: Recommendation E

Establish priority areas for riparian restoration and replant riparian areas with indigenous vegetation according to priority. Some significant areas to be considered for riparian restoration include:

- along headwater tributaries on Whistler Mountain (various locations along ski runs and maintenance roads)
- along east side of main stem adjacent to Arbutus Drive in Brio
- along main stem through Whistler Golf Course, on both east and west sides of Crabapple Creek; and
- from the north end of Whistler Golf Course to the confluence with the River of Golden Dreams.

Objective 2: Recommendation F

Identify and protect ecologically sensitive areas within the watershed (e.g. wetlands, unique ecosystems). Identified ecologically sensitive areas should either be permanently protected from development (e.g. park designation, conservation trusts) or designated as Development Permit Areas according to the Official Community Plan. Variances to Development Permit Areas may not be issued if the Board of Variance is of the opinion that the Variance would adversely impact the stream or riparian habitat of the watershed. These ecologically sensitive areas should be designated in conjunction with the Protected Areas Network proposed by the *Whistler Environmental Strategy*, utilising both RMOW Talisman mapping inventory and the Streamside Protection Policy Directive 'Streamside Protection Area' classification system.

Objective 2: Recommendation G

Amend the municipal Tree Protection Bylaw (RMOW Bylaw # 1333) to prevent tree cutting and other vegetation removal in the protective riparian zones as outlined above in Recommendation B.

Objective 2: Recommendation H

Assess and minimise potential impacts of shoulder season recreation activities around the stream and riparian area through educational signs or barriers where appropriate (e.g. mountain bike park on Whistler Mountain).

Objective 2: Recommendation I

Assess the Crabapple Creek watershed according to the *Proper Functioning Condition* (PFC) method as proposed by Patrick Lucey and Brian LeCas to the WFSG in August 1999 and at the Whistler International Proper Functioning Conditions Symposium, October 5-7, 1999. Recommendations of the CCWMP should be amended according to significant findings.

Objective 2: Guidelines

The following Guidelines should be considered in order to restore and protect the health of riparian areas along Crabapple Creek and its tributaries.

- Full riparian area protection (i.e. greater than 50m) should be encouraged and implemented whenever possible.
- Riparian restoration to a minimum of 15m in width should be implemented in existing developed areas wherever possible (e.g. along main channel throughout the Whistler Golf Course).

4.3.5.3 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN OBJECTIVE 3: RECOMMENDATIONS AND GUIDELINES

This section states the third Objective of the CCWMP and details the Recommendations and Guidelines that will contribute to achieving this Objective. The fulfilment of the Recommendations and Guidelines listed for Objectives 2 and 4 will contribute to achieving this Objective. This Objective and its accompanying Recommendations and Guidelines reflect key stakeholder input as well as relevant information gained from the literature review. This Objective recognises the potential for upland and valley development to alter

natural peak and low flows for a given stream system. While changes in peak and low flows may result from development related activities such as increased impervious area, stream channelisation and culverts, the natural drainage capacity of the channel remains unaltered, potentially raising flood hazards significantly. Such alterations can also reduce the channel's capacity to disperse naturally occurring sedimentation (i.e. by preventing natural channel meandering). This can lead to excessive sediment deposits in lower reaches, sometimes requiring, as in the case of Crabapple Creek, the dredging of the main channel after flood flow events. The following Recommendations and Guidelines attempt to address the various issues related to impacts of development, stormwater management, flood hazards, and maintaining/restoring natural hydrologic functions contributing to instream habitat values.

Objective 3

Development related impacts to the hydrologic characteristics of Crabapple Creek and its tributaries are minimised.

Objective 3: Recommendation A

Install a gauging station to establish the discharge patterns of Crabapple Creek in base, peak and low flow events. These data will assist in determining tendencies in flows, which will provide important information for future stormwater management, flood hazard, and restoration decision making. A potential site for the placement of the gauging station is at the downstream, or north, end of the culvert crossing beneath Highway 99.

Objective 3: Recommendation B

Restrict increase in the total impervious area (TIA) of the Crabapple Creek to protect overland and groundwater flows. The TIA of Crabapple Creek should not exceed 12% (i.e. ~2% above current total impervious area). This Recommendation recognises impervious area as an important biophysical indicator of watershed health as discussed in the literature. Numerous studies have shown that stream degradation occurs at relatively low levels of imperviousness (10-20%). This threshold of %12 for the Crabapple Creek watershed is aimed at allowing limited further development activity (e.g. expansion of the Valley Trail)

while ensuring that the TIA remains at the lowest level possible. Effective impervious area (EIA) is another important indicator that relates to maintaining the natural hydrologic conditions of a stream system. The EIA of a watershed is generally lower than the TIA, as runoff enters the channel at a slower rate (e.g. through ditches rather than storm sewers). The EIA of the Crabapple Creek watershed should not exceed 8-9%.

Means of implementing this Recommendation through municipal policy options (e.g. zoning, bylaws, Development Permit Areas) should be investigated. This Recommendation might be accomplished partially through implementing a site coverage requirement allowing no more than a set percentage of impervious area per lot. The allowable percentage of impervious area coverage per lot might be established according to zoning classification. Means of complementing this Recommendation through ecological restoration initiatives should be explored.

Objective 3: Recommendation C

Conduct a reach by reach naturalisation of Crabapple Creek's lower section, north of Highway 99. This Recommendation is aimed at restoring/maintaining the natural capability of the channel to effectively disperse sediment and conduct peak flows, as well as providing enhanced habitat value. Naturalisation would entail the removal of riprap, currently used for bank stabilisation, and the expansion of Crabapple Creek's riparian zone.

A moderate redesigning of the Whistler Golf Course, where opportunities arise, will more effectively accommodate the proper functioning ecological conditions of the lower reaches of Crabapple Creek. Potential redesigning of the golf course should incorporate more intensive sediment control measures (e.g. a larger pond system at the south end of the golf course with a bypass mechanism to help prevent heavy flows from flushing captured sediment back into the main channel). Potential redesigning should also include the provision of a wider riparian area, providing more potential for naturally occurring instream complexity and natural channel meandering and pool/riffle step formation. Fiscal responsibility for this Recommendation should be shared among watershed stakeholders, and not be solely that of the Whistler Golf Course.

Objective 3: Recommendation D

Minimise flood hazards by implementing flood protection measures appropriate to achieving other CCWMP Objectives.

Objective 3: Recommendation E

Where sediment removal from the main stem is required to restore channel drainage capacity, carry out these works recognising the need to reinstate natural riparian vegetation and instream complexity (i.e. large woody debris, pool/riffle sequencing, substrate composition) to as near pre-flood state as possible or, considering the current lack of complexity, better.

Objective 3: Recommendation F

Emphasise infiltration and detention in stormwater management initiatives by implementing appropriate best management practices for ecological health. This Recommendation recognises various aspects of stormwater management as important features in effective integrated watershed management plans, as discussed in the literature review. Best management practices (BMPs) may be found by examining various advancements in legislative and mitigative actions by other municipalities and regions (e.g. District of North Vancouver), environmental consulting firms (e.g. Kerr Wood Leidal Associates Ltd.), and educational institutions (e.g. Center for Watershed Protection) towards protecting the ecological integrity of stream and watershed resources. The internet is recommended as a useful source for researching current BMPs.

Objective 3: Recommendation G

Implement mitigation techniques, where groundwater flows have been significantly altered by development activities, in keeping with “soft” or natural engineering to restore the natural storage capacity of stream flows (e.g. construction of appropriately placed retention and detention ponds).

Objective 3: Recommendation H

Develop a municipal master drainage study and accompanying master drainage plan to deal with issues such as natural flows and channel drainage capacities, stormwater management policies, flood control, point and nonpoint source pollution, and the maintenance of waterways and drainage corridors.

Objective 3: Guidelines

The following Guidelines should be considered in order to minimise impacts to the hydrologic characteristics of Crabapple Creek and its tributaries associated with development.

- Mitigative measures and restoration initiatives should emphasise a long term, holistic watershed approach to addressing sedimentation rather than implementing short term "quick fix solutions" that tend to deal only with reducing the symptoms or *effects* rather than dealing with the *actual causes* of the problem at hand (e.g. site specific erosion control to reduce sedimentation will not address contributing causes such as increased velocity due to channelisation and artificial stabilisation or increased runoff rates due to increased impervious area.)
- Construction and maintenance should be sensitive to the ecological needs of the watershed.
- Development on known unstable floodplains should be restricted.
- Naturalisation and restoration efforts should emphasise bioengineering solutions.
- Established riparian setbacks should be left between top of bank and training berm where building on floodplains is deemed necessary.
- Development should be clustered, aiming for maximum density per area, thereby reducing urban sprawl.
- A zero net increase in stormwater runoff should be planned from sites after development (i.e. seek to maintain the predevelopment hydrologic flow patterns).
- The use of underground storm drainage systems should be avoided.
- Steam crossings (i.e. by roads, trails, etc.) should be minimised.
- Bridges, not culverts, should be used where stream crossings are necessary.

- Culverts, where necessary, should provide for fish passage. Existing culverts should be retrofitted to provide fish passage.
- Disconnection of roof leaders should be encouraged.
- Bridges should cross the stream at right angles
- Bridge spans should equal 1.5 times the bank full width or as required for flood passage as determined by a professional engineer, whichever is wider.
- Paved areas should be reduced where opportunities exist:
    - reduce residential road lengths and widths
    - reduce parking lot sizes
    - utilise cul-de-sac donuts (vegetation island in centre)
    - reduce radius of cul-de-sacs
    - reduce size of parking stalls
    - angle parking spaces
    - install pervious surface residential driveways
    - install pervious spillover parking areas
- Grassy swales and open gutters should be used rather than curbs.
- New buildings should be equipped with cisterns, rain barrels, and other grey water recycling systems, while old ones should be retrofitted where possible.
- As a minimum standard, the RMOW draft "Construction Guidelines and Environmental Monitoring Protocol" should be complied with for circumstances or conditions not accounted for in the CCWMP or other applicable regulations.

4.3.5.4 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN OBJECTIVE 4: RECOMMENDATIONS AND GUIDELINES

This section states the fourth Objective of the CCWMP and details the Recommendations and Guidelines that will contribute to achieving this Objective. The fulfilment of the Recommendations and Guidelines listed in all of the above Objectives should contribute to achieving this Objective.

Objective 4

Riparian and aquatic ecosystems continue to support a healthy assemblage and populations of fish and aquatic invertebrates.

Objective 4: Recommendation A

Examine and adjust where necessary fish habitat rehabilitation/stream restoration projects already planned for the watershed to ensure that they coincide with a watershed-based approach to restoration (re: recommended projects outlined in the *Whistler Region Fisheries Stewardship Plan*, Thomson 1996). Recommendations A and B reflect the emphasis placed by the literature on ensuring a watershed approach to stream restoration. A watershed approach to restoration entails re-establishing the fundamental natural channel hydrology in order to improve local habitat conditions. To do this, stream restoration projects must be expanded beyond isolated instream projects to include rehabilitation of upslope and riparian conditions that cause downstream fish-bearing stream habitats to decline. Potential projects should be identified and prioritised in part by considering broader aspects of ecosystem function and watershed condition. See **Appendix B** for useful guidelines regarding stream restoration projects.

Objective 4: Recommendation B

Design and complete further stream restoration projects to restore fish spawning and rearing habitat and natural stream and riparian functions.

Objective 4: Recommendation C

Investigate and implement ecologically sensitive alternatives to present winter snow removal debris placement activities to reduce sedimentation in stream channels. These alternative measures should be communicated to and carried out by both RMOW Roads and Drainage crew and the Ministry of Transportation and Highways. Any privately contracted snow removal operators should be informed of the instream habitat issues related to snow removal debris entering waterways and should be advised of appropriate mitigative measures. Some alternative options to present activities include placement of sediment fences and revegetation of reduced riparian areas where Crabapple Creek flows adjacent to

or crosses beneath roads. The narrowing of road widths in specific areas should be considered to accommodate effective riparian restoration (e.g. Arbutus Drive in Brio).

Objective 4: Recommendation D

Investigate and implement alternatives to the presently utilised winter road salt containing arsenic in order to eliminate the potential for deposition of harmful chemicals into stream channels. These alternative measures should be communicated to and carried out by both RMOW Roads and Drainage crew and the Ministry of Transportation and Highways. Any privately contracted snow removal operators should be informed of the instream habitat issues related to snow removal debris entering waterways and should be advised of appropriate mitigative measures.

Objective 4: Recommendation E

Require mitigative measures for stream protection during all development/construction activities within the watershed. Developers should comply, as a minimum standard, with the RMOW draft "Construction Guidelines and Environmental Monitoring Protocol" for circumstances or conditions not accounted for in the CCWMP or other applicable regulations. Further examples of such requirements include:

- sites must be covered when not active;
- construction must not occur during rainfall;
- all wastewater must flow through a sediment control pond constructed adjacent to larger development sites prior to discharge;
- materials must not be stockpiled on road surfaces; and
- site grounds must be covered by bark mulch or other similar material to reduce the tracking of soil onto roads.

Objective 4: Recommendation F

Require oil/water and/or oil/grit separators for all high-risk developments (e.g. commercial, industrial) and high-risk locations (e.g. Highway 99 intersections, parking lots) within the watershed.

Objective 4: Guidelines

The following Guidelines should be considered in order to help ensure that riparian and aquatic ecosystems continue to support a healthy assemblage and populations of fish.

- All fish habitat rehabilitation plans should be based on a watershed approach.
- Alternative, non-chemical-based pest management and turf maintenance practices should be strongly encouraged on the Whistler Golf Course.
- Alternative, non-chemical-based snowmaking activities should be strongly encouraged on Whistler Mountain.
- Alternative, non-chemical-based fertilisers and course maintenance practices should be strongly encouraged on Whistler Mountain.

4.3.5.5 SUMMARY OF RECOMMENDATIONS

This section presents a table (**Table 2**) summarising the Recommendations according to each Objective and details the following for each Recommendation: responsible stakeholder(s); estimated cost; and associated timeline for completion or continuance.

Table 2 Summary of CCWMP Recommendations, responsible stakeholders and schedule to completion

Recommendation	Responsible Stakeholder	Start Date	Finish Date
Objective 1: Education and Stewardship			
A. General information brochure	CCWMP Coordinator	Completed: July 1999	
B. *Crabapple Creek Interpretive Strategy*	RMOW Parks & Rec. Whistler/Blackcomb Whistler Golf Course WFSG	February 2000	Ongoing
C. Key stakeholder staff education	RMOW Parks & Rec. RMOW Public Works Whistler/Blackcomb Whistler Golf Course	February 2000	Ongoing
D. Education programs	WFSG RMOW Parks & Rec.	May 2000	Ongoing

E. Stewardship guide for residents	RMOW Parks & Rec. WFSG	February 2000	Ongoing
F. CCWMP Information brochure	RMOW Parks & Rec.	March 2000	March 2000
G. Multipurpose interpretive display	WFSG RMOW Parks & Rec.	May 2000	June 2000
H. BC Rivers Day activities	WFSG RMOW Parks & Rec. Whistler/Blackcomb Whistler Golf Course	September 1999	Ongoing
I. Newspaper articles	WFSG RMOW Parks & Rec.	February 2000	Ongoing
Objective 2: Riparian Areas			
A. Identify/classify tributaries	RMOW Parks & Rec. RMOW Planning	February 2000	April 2000
B. Complete mapping inventory	RMOW Parks & Rec. RMOW Planning	February 2000	June 2000
C. Implement riparian setbacks	RMOW Planning RMOW Parks & Rec.	February 2000	Ongoing
D. Require compensation	RMOW Parks & Rec. RMOW Planning	February 2000	Ongoing
E. Riparian restoration	WFSG RMOW Parks & Rec. Whistler Golf Course Whistler/Blackcomb	February 2000	Ongoing
F. Identify/protect ecologically sensitive areas	RMOW Parks & Rec. RMOW Planning	February 2000	Ongoing
G. Amend Tree Protection Bylaw	RMOW Parks & Rec. RMOW Planning	February 2000	March 2000
H. Assess/minimise off season recreational impacts	Whistler/Blackcomb RMOW Parks & Rec. Whistler Golf Course	May 2000	Ongoing
I. Assess watershed according to Proper Functioning Condition method	WFSG RMOW Parks & Rec.	Indefinite	Indefinite
Objective 3: Hydrologic Characteristics			
A. Install gauging station	RMOW Public Works	March 2000	March 2000
B. Restrict increase in total impervious area	RMOW Planning RMOW Parks & Rec. RMOW Public Works	February 2000	Ongoing
C. Consider reach by reach naturalisation of lower section	Whistler Golf Course RMOW Parks & Rec. RMOW Public Works	Indefinite	Indefinite

	RMOW Planning WFSG		
D. Minimise flood hazards	RMOW Public Works	February 2000	Ongoing
E. Conduct sensitive sediment removal	RMOW Public Works RMOW Parks & Rec. Whistler Golf Course	When required	
F. Emphasise infiltration and detention in stormwater management (BMPs)	RMOW Public Works	February 2000	Ongoing
G. Mitigate disruption to groundwater flows	RMOW Public Works RMOW Parks & Rec.	May 2000	Ongoing
H. Municipal master drainage study and plan	RMOW Public Works	Indefinite	Indefinite
Objective 4: Healthy Fish and Invertebrate Populations and Assemblage			
A. Adjust existing fish habitat restoration plans	WFSG RMOW Parks & Rec.	March 2000	July 2000
B. Design and complete stream restoration projects	WFSG RMOW Parks & Rec.	Spring 2000	Ongoing
C. Implement alternatives to current snow removal debris placement	RMOW Public Works BC Ministry of Transportation & Highways (BC MTH) Relevant Contractors	February 2000	Ongoing
D. Implement arsenic-free winter road salt	RMOW Public Works BC MTH Relevant Contractors	February 2000	Ongoing
E. Require mitigative measures during construction/development activities	RMOW Public Works RMOW Planning	February 2000	Ongoing
F. Require oil/water and/or oil/grit separators for high risk developments/locations	RMOW Public Works RMOW Planning	December 1999	Ongoing

4.3.6 EDUCATION AND INTERPRETIVE OPPORTUNITIES

A critical aspect of achieving a healthy resort community watershed is public education. This project proposes the development and implementation of a creative and comprehensive interpretive strategy throughout the Crabapple Creek watershed. A network of signs, interactive demonstrations, and other innovative tools will tell the story of Crabapple Creek

from its headwaters to the mouth, educating recreationists along the way about the unique history and ecology of the watershed.

This section of the CCWMP emphasises the importance of education and interpretive initiatives in relation to achieving the first Objective, encouraging stewardship on the part of local government, residents and visitors. It outlines the planned initiatives of the *Crabapple Creek Interpretive Strategy* and details the chosen watershed logo, themes and messages for the Crabapple Creek watershed. The content of the *Crabapple Creek Interpretive Strategy* is intended to reflect the various principles for effective interpretation discussed in the literature review.

4.3.6.1 WATERSHED LOGO AND INTERPRETIVE THEMES AND MESSAGES

A logo design and a core of fundamental watershed themes will be developed for the interpretive element of the CCWMP. It will unify the signage and other interpretive medium used throughout the watershed. Key messages will be designed to raise the interest of and provide enjoyable learning opportunities for local and international audiences. All of these themes, messages and topics will be communicated in a simple, understandable yet creative and engaging manner. They will be designed to stimulate visitors and enhance their overall experience of the watershed.

Crabapple Creek Watershed Logo

Residents and visitors will become familiar with the logo for the Crabapple Creek watershed (**Figure 6**), which appears on the front cover of the "Welcome to Your Watershed: Celebrating Crabapple Creek" information brochure. This logo will be the common visual theme, identifying everything on which it appears as being connected to the Crabapple Creek watershed.

Figure 6: The Crabapple Creek watershed logo

The logo depicts the fruit of the Pacific crabapple tree, signifying the presence of this riparian species within the watershed leading to the name of this creek system. The crabapple stem depicts a coniferous tree, signifying the importance of an intact riparian zone to the ecological integrity of the creek. The leaf on the stem portrays a person, signifying the people, the community of the Crabapple Creek watershed. The people of this community are the stewards of this valued watershed, and it is they who will help achieve the Vision of a healthy Crabapple Creek into the future.

The logo also depicts two fish, representing the presence of the rainbow trout and kokanee salmon in the Crabapple Creek system. These two important species of fish produced within Crabapple Creek are a focus of the community, and are often the focal point for education and restoration activities. The two fish are shown in a pattern resembling the yin yang illustration of eastern mythology, signifying the importance of unity and wholeness within the watershed. Steep mountainous headwaters connect to gentle lower reaches, elements of land and water work together to create a healthy working system, and people learn more about their environment so that human activities have less negative impacts.

Celebrating Crabapple Creek

"Celebrating Crabapple Creek" will be the *overarching theme* for the watershed, emphasising the community embracement of this interconnected local resource. This watershed supports a variety of community social and ecological values, from hosting salmonid spawners and juveniles and other wildlife to accommodating part of Whistler village itself, several neighbourhoods, and a significant portion of Whistler Mountain, one of the world's most renowned ski areas. The theme "Celebrating Crabapple Creek" will echo in interpretive media throughout the watershed, generating a positive attitude towards local natural ecosystems.

The Little Creek That Could

"The Little Creek That Could" will be a *sub-theme* discussing changes to the watershed as a result of urban, and recreational development over time. Interpretive media will discuss the creek's resilience to disturbances to date, but will emphasise the importance of recognising limits to any ecosystem's level of tolerance.

Topics to be covered by interpretive media relating to this sub-theme include:

- general background information about historical watershed characteristics and condition (natural ecological history, geology, etc.);

- general history of development in the watershed (timber extraction, Village construction, Whistler Mountain recreational development, construction of the Whistler Golf Course); and
- potential impacts of certain types of development on watersheds (impervious area and hydrologic/biological impacts).

Walk With the Rainbow

"Walk With the Rainbow" will be another *sub-theme* for the watershed interpretive strategy. It will highlight the presence of rainbow trout in Crabapple Creek. This theme will be a primary focus of the lower basin, as the main stem is where rearing and spawning habitat are found. However, this theme will also be manifest in the upper basin, emphasising the importance of healthy headwater areas for good downstream habitat conditions. Topics to be covered in interpretive media relating to this sub-theme include:

- life cycle of a rainbow trout;
- migration patterns of Crabapple Creek rainbow trout;
- habitat needs of juvenile and adult rainbow trout emphasising instream hydraulic conditions such as pool/riffle sequencing, meander patterns, and flow dynamics; and
- importance of headwater areas contributing to lower basin habitat conditions.

Fish Grow on Trees?

"Fish Grow on Trees?" will be a *message* emphasising the importance of riparian integrity for fish habitat in the Crabapple Creek Watershed. Topics to be covered in interpretive media relating to this message include:

- types and characteristics of riparian vegetation in the watershed; and
- functions of riparian vegetation related to hydrology and habitat (bank stabilisation, pollutant filtering, large woody debris, instream cover, channel morphology, oxygenation, etc.).

Whistler Cares for Creeks!

"Whistler Cares for Creeks!" will be a *message* emphasising the stewardship and restoration activities of Whistler local government and community groups in the Crabapple Creek watershed. Topics to be covered in interpretive media relating to this message include:

- various Whistler groups and partnerships involved in watershed stewardship initiatives (e.g. WFSG, AWARE, Habitat Improvement Team, and Whistler Naturalists);
- stream monitoring initiatives of community groups;
- instream restoration initiatives of community groups (highlight at appropriate sites);
- riparian restoration initiatives of community groups (highlight at appropriate sites); and
- community stewardship groups' involvement and participation in developing and implementing the CCWMP.

Stream Restoration: The Bigger Picture

"Stream Restoration: The Bigger Picture" will be a *message* emphasising the importance of taking a watershed-based approach to instream/fish habitat restoration. Topics to be covered in interpretive media relating to this message include:

- why "quick fix" responses do not always work (band-aid solutions);
- need to address the causes of stream problems, not just mitigate the effects; and
- some examples of both types of restoration initiatives (root wad placement vs. re-establishing natural stream geometry and pool/riffle sequencing).

4.3.6.2 THE CRABAPPLE CREEK INTERPRETIVE STRATEGY

The *Crabapple Creek Interpretive Strategy* is aimed at guiding a coordinated approach to interpretive initiatives within the watershed, emphasising the themes, messages and topics listed above. The following segment details the main components of the *Crabapple Creek Interpretive Strategy*, outlining specific initiatives, site locations and potential themes and messages to be conveyed.

Interpretive Strategy Initiative 1: Interpretive Signs

Interpretive signs are an effective means of conveying desired messages and information to people as they explore different areas of the watershed. To emphasise consistency throughout the watershed, interpretive signs will include the Crabapple Creek Watershed Logo, the overarching theme "Celebrating Crabapple Creek", and may include a focus on any/all of the above mentioned sub-themes, messages and topics. All signage architecture should be based on the template of the RMOW cedar frame map kiosks currently used to display maps and information throughout the village area (**Figure 7**). Interpretive signs should include a watershed map.

Figure 7: Sample architecture of Crabapple Creek watershed interpretive signs

Three *priority demonstration sites* to be developed in the watershed should be located:

1. at the north end of the Whistler Golf Course where Crabapple Creek is crossed by the Valley Trail footbridge near large cedar, spruce and fir trees.
2. in Brio at the entrance to Sunridge Plateau where the Sunridge Place road bridge arches over Crabapple Creek. Two opportunities for signage placement include: beneath the bridge, placed such that pedestrians and vehicle passengers on Panorama Ridge facing upstream may view; and just above the bridge, adjacent to Crabapple Creek where the mailbox kiosk is located.
3. on Whistler Mountain around the new Garbanzo Lift base (at Mid Station) where major headwater tributaries of Crabapple Creek converge.

Other recommended sites for placement of interpretive signage include:

- Brio entrance beside Crabapple Creek (creek is basically a ditch at this point)
- at footbridge crossing Crabapple Creek south-east of Sunridge Plateau development (just downstream of tributary confluence)
- along the Valley Trail at the following locations:
    - Highway 99 culvert crossing at south end of Whistler Golf Course
    - road bridge crossing Crabapple Creek just upstream from confluence with River of Golden Dreams
    - various sites along Blueberry Trail on west side of Whistler Golf Course
    - various sites along east side of Whistler Golf Course
- Whistler Village South at the following locations:
    - by storm drains discharging into Crabapple Creek
    - along the tributary to Crabapple Creek by the Whistler Golf Course Driving Range
- Whistler Golf Course at the following locations:
    - sediment ponds
    - along reconstructed section of Crabapple Creek (west side)
    - along tributary on east side of golf course
- Whistler Mountain at the following locations:

- at base of mountain
- mountain bike park area at Mid Station
- on lift line and gondola poles (for passengers to view as they ascend; these signs will afford a holistic, panoramic perspective)

Interpretive Strategy Initiative 2: Watershed Walks

Biweekly or monthly Watershed Walks throughout the Crabapple Creek watershed (upper and lower basins) should be conducted in the snow-free months. Walks might be led by local experts and naturalists familiar with local flora, fauna, fish, and general Crabapple Creek watershed issues. Information links to visitors and tourists about watershed walks might be achieved through posters in the village area, as well as through communication by various stakeholder groups such as the Whistler Golf Course (Tourism Whistler), Whistler/Blackcomb and adventure tour operators.

Interpretive Strategy Initiative 3: Interactive Internet Site

As more and more people around the world tune in to the Internet as a means of entertainment and learning, world wide web sites have become an extremely effective means of communication. The establishment of an interactive web site could provide virtual visitors with opportunities to learn about watershed issues and stewardship initiatives in Whistler. A Crabapple Creek watershed web site will offer an exciting avenue for interpretive communication and feedback. Raising the profile of Crabapple Creek by this dynamic venue will offer advanced occasions for environmental learning and will help to demonstrate the commitment of the Whistler community to environmental stewardship.

This web site might be developed in conjunction (i.e. as a link) with a more comprehensive site relating to RMOW environmental initiatives. However, to maximise audience size and breadth, a web site in conjunction with that of a more aggressive communication agent such as Tourism Whistler or Whistler/Blackcomb would be ideal.

Interpretive Strategy Initiative 4: Self Guided Trail Network

The development of a watershed wide trail network will provide opportunities to connect interpretive sign locations and enhance recreation opportunities for residents and visitors. The trail need not be paved or entail high maintenance. Rather, the network may simply require the "highlighting" of existing roads and trails as being part of the Crabapple Watershed. M might also be developed to illustrate potential navigable routes.

Interpretive Strategy Initiative 5: Slide Show Presentation

The assemblage of an organised slide show with accompanying text and/or pre-recorded tape may be used to entertain and educate people about various aspects of the Crabapple Creek watershed. The slide show will tell the story of Crabapple Creek from its geologic origins and predevelopment state to its current existence as home to rainbow trout and kokanee salmon and as a model for stewardship initiatives in British Columbia. The slide show could consist of images of Crabapple Creek in all seasons, highlighting various historic and anecdotal events and uses through visuals and spoken text. The watershed themes and messages for Crabapple Creek, as outlined in section 4.3.6.1, may be used to provide organisation for presentation topics. This prepared slide show with text/tape may be presented to a wide variety of audiences for diverse occasions and purposes. Text and images may be altered and added to according to the purpose of each presentation.

Some examples of possible slides include:

- aerial photos and/or maps locating the Crabapple Creek watershed;
- aerial photos of the Crabapple Creek watershed before and after development;
- various human activities within the watershed and in and around the creek (e.g. Whistler Mountain ski hill activities, River Life program, fish monitoring, volunteer work, riparian planting, restoration projects, and Whistler Golf Course activities);
- rainbow trout spawning in the lower reaches of Crabapple Creek;
- innovative interpretive signage and/or kiosks around Crabapple Creek;
- wildlife in or around Crabapple Creek;
- riparian vegetation (or lack thereof) adjacent to Crabapple Creek; and

- lower reaches of Crabapple Creek before/during/after development of the whistler Golf Course.

Interpretive Strategy Initiative 6: Video

This video may be similar to the slide show presentation (Initiative 5) but will include animated visuals and dialogue. This video could illustrate the sights and sounds of Crabapple Creek in all seasons, and will highlight recent stewardship initiatives of community residents and organisations. This video may be presented to a variety of audiences for a diversity of occasions. This video might be utilised for demonstrating the efforts of Whistler in environmental stewardship and community awareness and participation, as well as watershed protection and restoration. The video could incorporate the themes and messages outlined above in section 4.3.6.1. There is potential to incorporate this video, or portions thereof, into the proposed interactive internet site (Initiative 3).

4.3.7 IMPLEMENTATION OPPORTUNITIES AND COMMITMENTS

For any resource management plan to be successful in achieving its goals there must be resolution on the part of stakeholders to uphold and implement the directives of the plan, to monitor progress, and to adapt objectives and actions according to changes in conditions. This section outlines opportunities for implementation and monitoring, to record changes and progress towards achieving the Vision for the Crabapple Creek watershed. The implementation program outlined here reflects the critical importance placed on implementation in the literature, as discussed in Chapter Two. The recommendations for CCWMP implementation are intended to establish a management structure that can be sustained over the life of the watershed management process. They are meant to facilitate the commitment of key stakeholders and to help ensure continued progress towards achieving the Objectives of the plan.

4.3.7.1 CRABAPPLE CREEK WATERSHED MANAGEMENT COMMITTEE

The fulfilment of goals in any resource management plan requires the long-term commitment of stakeholders. To facilitate the implementation and future effectiveness of the CCWMP, an ongoing *Crabapple Creek Watershed Management Committee* comprised of key stakeholders and decision makers should be formed upon approval of the document by RMOW Council.

The *Crabapple Creek Watershed Management Committee* will be comprised of representatives from the following groups (this list may be amended as circumstances oblige):

- CCWMP Coordinator;
- watershed residents;
- Whistler Fisheries Stewardship Group;
- RMOW Parks and Recreation Department;
- RMOW Public Works Department;
- RMOW Planning Department;
- BC MELP Stewardship Advisor;
- Whistler/Blackcomb (Intrawest);
- Whistler Golf Course (Tourism Whistler); and
- independent tourism operators.

The *Crabapple Creek Watershed Management Committee* should ideally meet 3 to 4 times annually (or as required) to discuss changing conditions in the watershed as revealed by monitoring initiatives, emerging management issues, and progress to date in accomplishing the Recommendations and moving towards fulfilling the Objectives of the CCWMP. The monitoring indicators suggested by the CCWMP (section 4.3.8) should help determine trends and changes in watershed condition, as well as measuring progress towards completing the Recommendations of the CCWMP. The *Crabapple Creek Watershed Management Committee* should be responsible for amending the CCWMP according to

need, as the document is meant to be adapted with changing conditions and desired directions.

A brief Annual Progress Report produced by the *Crabapple Creek Watershed Management Committee* will be critical in documenting advancements towards meeting the Objectives and in identifying necessary refinements of the CCWMP and related initiatives.

The Crabapple Creek Watershed Management Committee will monitor the overall success of the CCWMP. A comprehensive Watershed Health Summary Report will be produced every 3-5 years, documenting changes in watershed conditions utilising the monitoring indicators listed in section 4.3.8. This report should evaluate whether the general health of the watershed is improving, degrading or remaining constant. A key guiding question concluding this report should be: "Is CCWMP implementation resulting in movement towards a watershed state that meets the Vision and Objectives of the plan?". If not, then the *Crabapple Creek Watershed Management Committee* should evaluate and amend indicators and Recommendations to meet emerging circumstances.

4.3.7.2 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN IMPLEMENTATION TEAM

The CCWMP *Implementation Team* will be an internal RMOW team responsible for implementing legislative changes recommended by the CCWMP. The CCWMP *Implementation Team* will be comprised of RMOW staff familiar with policy issues and municipal legislative process. The Implementation Team will formulate appropriate bylaw, zoning, and other policy amendments to effectively employ specific Recommendations of the CCWMP (e.g. protective riparian setbacks).

The CCWMP *Implementation Team* will be assembled upon approval of the CCWMP draft by RMOW Council in spring 2000. Individuals to comprise the *Implementation Team* will be selected by key watershed stakeholders on the *Crabapple Creek Watershed Management Committee*.

4.3.7.3 MEMORANDUMS OF UNDERSTANDING

For effective implementation of the CCWMP, it is essential that key stakeholders and decision makers demonstrate commitment to the established Objectives, Recommendations and Guidelines for Crabapple Creek. As a type of policy tool, Memorandums of Understanding provide a formal means through which stakeholders and decision makers may state this commitment.

Potential key signatories of Memorandums of Understanding regarding commitment to upholding the Recommendations and Guidelines of the CCWMP include:

- Resort Municipality of Whistler;
- Whistler/Blackcomb;
- Whistler Golf Course;
- Tourism Whistler;
- Whistler Fisheries Stewardship Group;
- BC Ministry of Environment, Lands and Parks;
- community strata councils (bare land/condominium) within the watershed; and
- relevant property management firms (e.g. Whistler Resort Management, Crosby Property Management).

Upon the signing of one or several Memorandums of Understanding among the above stakeholders, the CCWMP will be more fully recognised as a formal document for guiding activities within the watershed.

4.3.8 MONITORING

The Vision and Objectives of the CCWMP establish the desired conditions for Crabapple Creek. The Recommendations and Guidelines lay out the first of many steps which will help reach and maintain those goals. Beyond developing goals and the measures needed to achieve them, it is essential that key indicators be monitored in order to determine progress

towards, or away from, these goals. In monitoring the effects of actions upon the watershed, approaches may be adjusted according to results and more effectively and efficiently restore and maintain the ecological health of Crabapple Creek.

To date, relatively little is known about trends in the condition of Crabapple Creek. There are recent data regarding some of the primary indicators of watershed health, but good baseline information has only just begun to be collected. Many of the following suggested indicators may prove vital in evaluating and monitoring changes in watershed conditions. Knowledge of trends, effects, and changing conditions is necessary so that appropriate and effective planning, management, and restorative decisions can be made.

This monitoring program proposed by the CCWMP reflects the emphasis placed by the literature on the fundamental importance of monitoring in integrated watershed management planning initiatives. Monitoring both biophysical indicators and progress of the plan towards achieving objectives is critical for effective watershed management.

The monitoring indicators suggested below are organised according to CCWMP Objective.

4.3.8.1 SUGGESTED INDICATORS: OBJECTIVE 1

Objective 1: *Resort community government, residents and visitors demonstrate a high level of watershed stewardship.*

Progress towards this Objective is not measurable by conventional biophysical indicators. It is possible, however, to get a sense of progress by monitoring trends in community awareness and involvement in watershed issues and initiatives.

The following suggested social indicators will help reveal progress towards fulfilling this Objective for Crabapple Creek:

a) timely implementation of all elements of the *Crabapple Creek Interpretive Strategy*;
b) participation of residents and/or visitors in watershed stewardship/restoration initiatives (e.g. volunteers for riparian planting, attendance at watershed walks);

c) familiarity with and understanding of key watershed issues by residents and visitors;
d) experience of environmental learning by residents and/or visitors as a result of interpretive signs, literature or demonstrations;
e) participation of key stakeholder group staff (e.g. RMOW, Whistler/Blackcomb, Whistler Golf Course) in environmental learning;
f) participation of schools in environmental learning and watershed stewardship;
g) development of new environmental or watershed stewardship groups;
h) development and maintenance of new and existing partnerships relating to environmental or watershed stewardship; and
i) frequency of newspaper articles relating to watershed issues and/or community initiatives in stewardship.

4.3.8.2 SUGGESTED INDICATORS: OBJECTIVE 2

Objective 2: *Riparian areas along Crabapple Creek and its tributaries are healthy, restored and protected.*

To monitor progress towards Objectives 2 and 3, the integrity of riparian ecosystems along Crabapple Creek must be assessed and evaluated according to changes within the system (e.g. restoration efforts, development, or naturally occurring conditions).

Monitoring should include a baseline evaluation establishing what percentage of riparian vegetation is sufficiently intact along both the main stem and headwater tributaries. This can be done through ground surveying or orthophoto analysis (the mapping inventory must first be completed for the watershed). Priority areas for restoration to restore natural riparian characteristics and functions may then be selected. Monitoring should be conducted annually to determine changes in riparian integrity throughout the watershed.

The following biophysical indicators may be used to assess riparian conditions and relevant changes within the watershed over time:

a) percent stream length with intact riparian zone;

b) number of plants effectively planted (i.e. alive one year later) in riparian zone restoration initiatives;
c) diversity in age/class structure of riparian species;
d) diversity in composition of riparian wetland vegetation;
e) species presence indicative of riparian soil moisture characteristics;
f) species presence with root masses able to withstand high flow events;
g) adequate riparian cover to protect banks;
h) adequate natural source of small organic and large woody debris; and
i) potential for riparian widening.

4.3.8.3 SUGGESTED INDICATORS: OBJECTIVE 3

Objective 3: *Development related impacts to the hydrologic characteristics of Crabapple Creek and its tributaries are minimised.*

Hydrologic Characteristics

To ensure appropriate management decisions for stormwater management and fish habitat issues, critical information is needed pertaining to channel capacity and seasonal mean, peak and low discharge rates of the Crabapple Creek system. It is recommended here that stream discharge (i.e. mean, peak, and low flows) be used as a **key indicator** of trends in stream and watershed condition.

The following additional indicators should be primary in stream monitoring initiatives:

a) relative frequency of bankfull conditions;
b) relative frequency of low flow conditions; and
c) relative frequency and magnitude of flood stage conditions (e.g. frequency of above bankfull, magnitude of theoretical 2 year, 10 year, 100 year flood).

All of the above indicators may be measured with the installation of a gauging station on the lower reaches of Crabapple Creek, as suggested in section 4.3.5.3.

The following are other significant indicators suggested for assessing and monitoring the hydrologic characteristics of Crabapple Creek:

a) percent increase or decrease in total impervious area (TIA);
b) percent increase or decrease in effective impervious area (EIA);
c) sinuosity, width/depth ratio, and gradient in balance with landscape setting;
d) excessive erosion/sedimentation levels (sediment analysis); and
e) floodplain and channel characteristics (rocks, overflow channels and large woody debris) adequate to dissipate stream energy.

4.3.8.4 SUGGESTED INDICATORS: OBJECTIVE 4

Objective 4: *Riparian and aquatic ecosystems continue to support a healthy assemblage and populations of fish and aquatic invertebrates.*

Benthic Invertebrates

Benthic macroinvertebrates, large invertebrates which live on the bottom of lakes and streams, can provide critical information about the quality of instream habitat. The structure and composition of benthic communities in streams is strongly connected to the surrounding land environment and instream chemical, hydrologic, and geomorphologic gradients. As such, stream invertebrate communities can be appropriate candidates for use as aquatic ecosystem health indicators in mountain watersheds (Culp, Cash and Halliwell 1997).

It is recommended that, in addition to stream discharge, benthic macroinvertebrates be monitored as **key indicators** of stream and watershed health.

An extremely useful guide for benthic monitoring is provided by "Volunteer-Based Monitoring Program for the Salmon River: Using Benthic Indicators to Assess Stream Ecosystem Health" (Culp, Cash and Halliwell 1997). It is recommended that this document be used as a model for benthic monitoring in Crabapple Creek.

Water Quality

A key indicator of stream and watershed health, water quality can be tested continually and used as a reference for long term monitoring. Water quality results assist in identifying and evaluating problems in the watershed, such as consistently lower water temperatures or excessive sedimentation. Monitoring of water quality can assist in selecting necessary or appropriate restoration initiatives and can also help evaluate the effectiveness of completed restoration projects.

The following include some primary indicators of water quality that should be measured at least two times per year, in relevant seasons:

a) pH;
b) turbidity/suspended solids;
c) conductivity/dissolved solids; and
d) dissolved oxygen (percent saturation/absolute concentration).

It would be useful to conduct turbidity and conductivity measurements following spring freshets/heavy rain events and during low summer flows, as well as during normal base flows.

Water temperature should be monitored continually. This can easily be performed with the installation of a continuous data logger (i.e. ONSET Corp. model) at the site of the proposed gauging station.

The following parameters are good indicators of water quality that should be sampled periodically (e.g. annually during midsummer months) on the lower reaches of Crabapple Creek:

a) nitrates;
b) nitrites; and
c) phosphates.

Fish

Monitoring of fish presence can help determine the changing quality of habitat conditions and can help assess the success of restoration initiatives. Annual juvenile and spawning sampling should be conducted to continually assess trends and abundance for rainbow trout and Kokanee salmon. Monitoring should be conducted specifically on Crabapple Creek.

Fish Habitat

Continue annual habitat assessment surveys such as those conducted by L. Krzesinska to monitor changes in habitat quality and availability. These assessments will aid in the development of potential instream habitat restoration projects.

The following are indicators for reach surveys that will help determine status and changes in fish habitat conditions:

a) reach gradients;
b) percent pool habitat;
c) percent riffle habitat;
d) percent glide habitat;
e) substrate composition (percent fines, gravel, cobble boulder, bedrock);
f) substrate embededness (percent);
g) instream cover (percent log, boulder, cutbank, instream vegetation, overstream vegetation);
h) pieces of large woody debris per mean stream width;
i) obstructions to fish passage (e.g. impassable culverts); and
j) velocity of flow.

4.3.8.5 MONITORING PROGRESS TOWARDS THE CCWMP VISION AND OBJECTIVES

To monitor progress towards CCWMP Objectives, the *Crabapple Creek Watershed Management Committee* (section 4.3.7.1) should complete an Annual Progress Report. This Annual Progress Report will track Recommendations that have been implemented and will identify tasks still to be completed. Such reporting may also be helpful in prioritising

uncompleted Recommendations and in determining potential new Recommendations required to move further towards achieving the CCWMP's Objectives.

In addition to the suggested social, physical and biological indicators listed above, some other important indicators of progress towards fulfilling Objectives might include:

- the number of policy amendments concerning enhanced environmental stewardship;
- the number of zoning changes in favour of environmental preservation;
- the number of effective restoration projects completed; and
- percent area of watershed with protected status.

CHAPTER FIVE
MANAGEMENT AND MINDFULNESS IN A MOUNTAIN RESORT COMMUNITY

This chapter highlights several key components of the CCWMP in relation to their emphasis on encouraging environmental mindfulness among residents and visitors to Whistler's Crabapple Creek watershed. This is followed by a discussion of some of the unique opportunities and challenges of the Crabapple Creek watershed management planning experience related to the tourism-based resort nature of Whistler.

5.1 ENCOURAGING MINDFULNESS THROUGH THE CCWMP

Whistler recognises the importance of moving towards environmental sustainability for the long-term success of the resort community. In the 1993 Comprehensive Development Plan, the RMOW declares that "the high quality of the natural environment is one of the main reasons for Whistler's success as a resort and its attractiveness as a community" (Waldron 1999). This recognition is further demonstrated by Whistler's current leadership in environmental stewardship through initiatives such as the *Whistler Environmental Strategy* and the CCWMP.

Whistler also recognises the importance of community awareness and support in working towards environmental sustainability. The *Whistler Environmental Strategy* emphasises the role of community education and involvement by local government, business, groups and individuals in environmental initiatives (Waldron 1999). Providing learning opportunities will help foster a closer connection to nature, encouraging mindfulness and inspiring visitors, residents and tourism operators of the resort community to become involved with innovative local and even global stewardship opportunities. Several principal components of the CCWMP are aimed at increasing environmental awareness and mindfulness of watershed issues among residents and visitors.

5.1.1 WATERSHED MANAGEMENT STRATEGIES

The CCWMP conveys a strategy for helping ensure the restoration and maintenance of Crabapple Creek's ecological integrity. Beyond this, however, the CCWMP aspires to encourage mindfulness and environmental stewardship by residents and visitors. Recall Moscardo's (1999) notion of mindfulness, characterised by a state of active mental processing involving the creation of new cognitive categories. While Moscardo's research mainly concerns the mindfulness of *visitors* to a place, the CCWMP effectively extends the notion of mindfulness to include residents and long term members of the resort community. Without mindfulness on the part of resort community residents, it is unlikely that mindfulness among visitors will be achieved. Whistler is a community based largely on regular influxes of thousands of visitors. As such, it is essential that strategies for creating mindfulness be aimed at both principal sectors of the resort community, residents and visitors.

In looking at the CCWMP Objectives and Recommendations as established by key watershed stakeholders, it becomes clear that resident and visitor mindfulness are perceived as fundamental conditions for achieving and maintaining watershed health for Crabapple Creek. Indeed, the emphasis on encouraging education and mindfulness is evident from the first Objective of the CCWMP, which states: *Resort community government, residents and visitors demonstrate a high level of watershed stewardship*. The nine Recommendations that accompany this Objective all strive to foster education and mindfulness about watershed issues. The continued health of the Crabapple Creek watershed is largely dependent on the mindfulness of its stakeholders, including managers, residents and visitors. Without the awareness, cooperation and support of these stakeholders, the other Objectives of the CCWMP will not be achieved and the sustained health of the watershed itself may be compromised.

5.1.2 THE CRABAPPLE CREEK INTERPRETIVE STRATEGY

As outlined in the literature review, tourism and interpretation are becoming more recognised as having effects on increased learning and environmental attitudes. A critical emphasis on the interpretive element within the CCWMP will promote environmental awareness and education about Whistler's unique ecological characteristics. It will also provide a significant opportunity to educate residents and visitors about various aspects of ecological stewardship and restoration initiatives that are becoming essential to ensure the continued integrity of local ecosystems. The *Crabapple Creek Interpretive Strategy* will encourage mindfulness and incite members and visitors of the resort community to become involved with innovative local stewardship practices.

Principles for Encouraging Mindfulness

One of the five key principles proposed by Moscardo (1999) for encouraging mindfulness is to help visitors find their way. By this, Moscardo in part means that visitors should be well oriented to facilitate their effective reception of interpretive material. Moscardo (1992) notes that mindfulness is brought about more easily in those who are already familiar with the setting. As such, those who live and work in the watershed are more susceptible to learning and attitudinal change from interpretive efforts. However, watershed residents may not be familiar with the watershed in its entirety, as the upstream and downstream characteristics of Crabapple Creek differ greatly. Watershed residents, then, in addition to visitors, must be well oriented with the watershed in order to most effectively facilitate mindfulness and stewardship.

The *Crabapple Creek Interpretive Strategy* proposes several initiatives to help orient people with the Crabapple Creek watershed. Interpretive signs (Initiative 1) will portray a clear map of the watershed to help orient recreationists. A clear visual logo will identify all interpretive signs as being part of the Crabapple Creek watershed. This will facilitate orientation, as well as an understanding of watershed connectivity, as recreationists may see this logo anywhere from ski runs in the headwaters to signs on the Whistler Golf Course and

along the creek's mainstem by the Valley Trail. Watershed walks (Initiative 2) led by local experts familiar with local flora, fauna and watershed issues will both help orient residents and visitors and acquaint them with various aspects of the watershed.

The *Crabapple Creek Interpretive Strategy* also proposes a self-guided trail network throughout the watershed (Initiative 4). This trail network is designed to help familiarise residents and visitors with the watershed and promote an understanding of local watershed issues.

A further key principle for encouraging mindfulness is to tell a good story. This is one of the most fundamental of all interpretive principles. The *Crabapple Creek Interpretive Strategy* outlines a series of themes and messages which aim to "tell the story" of the Crabapple Creek watershed. The themes and messages outline aspects of this watershed story, ranging from fish life cycles and habitat needs to the impacts of development on the watershed and stewardship initiatives by local community groups. The diversity of themes and messages, along with the various different interpretive initiatives, fulfil another leading principle for encouraging mindfulness as proposed by Moscardo, that of providing variety in interpretive content and media. These themes and messages tell a story while making connections to residents and visitors and getting them involved. This later aim, getting people involved, is an additional key principle listed by Moscardo (1999) for encouraging mindfulness. Watershed walks and the interactive internet site will also foster direct participation, as will community restoration and stewardship events such as Arbour Day and Rivers Day.

5.3 UNIQUE OPPORTUNITIES

Whistler is unique among British Columbian communities, distinguished by its position as a world-class mountain resort. This section describes some of the unique opportunities provided by this resort environment in relation to the Crabapple Creek watershed management planning experience.

5.3.1 PROJECT INITIATION: THE *WHISTLER ENVIRONMENTAL STRATEGY* AS AN OPEN DOOR

Residents and visitors come to Whistler expecting to experience some aspect of the Canadian wilderness, to experience the majesty of the forest and mountains and the lakes and rivers. They do not expect to see clearcuts on the mountainsides or a landscape clouded with pollution. Much of the economic success of Whistler can be attributed to the beauty of its relatively undegraded natural environment. Protecting this environment, the tourism resource base of Whistler, has recently become a top priority for the RMOW and other community leaders. The capability to continually provide a high quality of life for residents and a high quality of experience for visitors depends significantly on preserving the integrity of Whistler's natural environment. The dependency of community and economic success on the environment lends a strategic advantage to Whistler in terms of taking a progressive approach to environmental issues. As a resort community based largely on the natural characteristics of its landscape, it is in the best interest of Whistler, economically and socially, to take innovative measures to ensure the continued ecological integrity and vitality of this landscape. Protecting critical habitat and ecologically sensitive areas, maintaining high water and air quality – these activities in a resort community such as Whistler are based not only (perhaps not even primarily) on a desire to protect nature for nature's sake, but on the necessity of maintaining the social and economic success that Whistler enjoys as a premier mountain resort community.

Recognising the importance of preserving the integrity of Whistler's natural environment, the RMOW has been a catalyst in the development of the *Whistler Environmental Strategy*. This *Strategy* has effectively started to bring environmental issues to the forefront in Whistler. The development of this document has greatly facilitated the introduction of numerous environmental matters into RMOW operations and management and will presumably have significant future influence on municipal policy modifications.

Undeniably, it was the existence of the *Whistler Environmental Strategy* that prompted the timely development of the CCWMP. The Crabapple Creek watershed management

planning initiative began largely as a model project to help demonstrate both the importance of planned watershed management and the potential of the *Whistler Environmental Strategy* for effecting positive environmental change. Owing to its central location within the Whistler community, its familiarity among residents and its status as the best fish spawning and rearing habitat in the valley, Crabapple Creek was strategically selected to illustrate ways in which the *Whistler Environmental Strategy* could be transformed into action. Thus far, the development of the CCWMP has been perceived by stakeholders and community media as an extremely positive endeavour (Beresford 2000). It is hoped that the CCWMP will facilitate implementation of other *Whistler Environmental Strategy* recommendations and that the momentum towards environmental sustainability will continue and even accelerate.

5.3.2 WATERSHED STAKEHOLDER INVOLVEMENT: WORLD CLASS STRATEGIC PARTNERSHIPS

Attaining the cooperation and involvement of critical stakeholders can be a challenge in any resource management initiative – perhaps even more so in Whistler, where the tourism resource base is centred largely around recreational facilities provided by two key Crabapple Creek watershed stakeholders. The Crabapple Creek watershed accommodates several world class recreational facilities, including the Whistler/Blackcomb ski area (owned by Intrawest Corporation) and the Whistler Golf Course (owned by Tourism Whistler). As key land users and decision makers within the watershed, Whistler/Blackcomb and the Whistler Golf Course play critical roles in watershed issues. The managers of these facilities have significant potential to influence the type and scale of activities that occur within the portions of the watershed under their authority.

Since 1996, both Whistler/Blackcomb and the Whistler Golf Course have been active partners of the WFSG, a local stewardship organisation. Other partners within the WFSG include the RMOW, AWARE, the Whistler Angling Club, the Rotary Club, the Chateau Whistler Golf Course and Nicklaus North Golf Course. The WFSG has been extremely

active in stream stewardship and restoration and in publicising the importance of stream habitat and watershed issues throughout the Whistler Valley.

WFSG partners played a vital role as stakeholders in the development of the CCWMP. Many WFSG partners provided input, information and insight regarding key issues within the Crabapple Creek watershed. Most significantly, however, the prior existence of the WFSG facilitated the support and extensive participation of two critical watershed stakeholder groups, Whistler/Blackcomb and the Whistler Golf Course. The Whistler/Blackcomb and Whistler Golf Course representatives in the WFSG are both senior operations managers of their respective facilities, thereby having significant influence on land use decisions and activities with potential impacts on the watershed. Through their involvement with the WFSG, these stakeholders have already been active participants in stream protection and restoration. As such, gaining the support and full participation of these two individuals on behalf of Whistler/Blackcomb and the Whistler Golf Course proved an easy task. Both organisations have embraced the essence of the CCWMP and are committed to working towards achieving the Vision for the Crabapple Creek watershed. Whistler/Blackcomb and the Whistler Golf Course have already begun contributing to the implementation of various Recommendations, such as the *Crabapple Creek Interpretive Strategy* and the partial redesigning of the golf course. The involvement of key representatives from Whistler/Blackcomb and the Whistler Golf Course in the development process of the CCWMP has also likely heightened their awareness of watershed issues and of their potential to influence appropriate management decisions for protecting the integrity of Crabapple Creek.

Whistler/Blackcomb and the Whistler Golf Course, both hosting world class recreational sites, are by nature relatively well financed. Although there was no initial financial contribution to the Crabapple Creek watershed management planning initiative, both organisations have agreed to allocate the necessary resources to fulfil their commitments to the CCWMP. The fiscal contribution and responsibility being demonstrated by these two substantial stakeholders will undoubtedly prove powerful in helping to achieve effective watershed restoration and protection for Crabapple Creek.

5.3.3 OUTDOOR RECREATION: A NATURAL FORUM FOR LEARNING

Outdoor recreation has been a catalyst in the development and success of Whistler as a premier mountain resort community. From Whistler/Blackcomb providing some of the best skiing and snowboarding terrain in the world, to three championship golf courses, exceptional parks and the Valley Trail system, recreation delivery is what Whistler does best. Residents and visitors come to Whistler for the abundant outdoor recreation opportunities and this provides a strategic advantage for promoting environmental learning and mindfulness about Crabapple Creek watershed management issues and initiatives.

The *Crabapple Creek Interpretive Strategy* has added potential to bring about visitor mindfulness as a result of its implementation in Whistler, a mountain resort community. Whistler visitors and residents are typically orientated towards outdoor experiences. Hence, getting people to visit interpretive sites throughout the Crabapple Creek watershed will be significantly facilitated by numerous existing outdoor recreation opportunities. These opportunities include activities associated with the use of the Valley Trail system, the Whistler Golf Course, Whistler/Blackcomb ski area, and other shoulder season activities such as hiking and mountain biking on Whistler Mountain. The *Crabapple Creek Interpretive Strategy* is aimed at taking advantage of the fact that people in Whistler love to spend time outdoors. It seeks to develop interpretive initiatives that foster learning about the natural environment while actually experiencing that environment.

5.3.4 THE IMPORTANCE OF IMAGE IN THE TOURISM DESTINATION MARKETPLACE

There is a growing awareness among mountain resort communities of the competitive marketing benefits of “going green”. Across North America, the vigorous competition among mountain resort communities and ski areas for premier status has recently begun to include an environmental component. Mountain resort communities are increasingly addressing local environmental issues to gain the edge on this aspect of destination image

and positioning (City of Aspen 1993; Town of Vail 1994). The old adage "everyone is doing it" rings true as North American mountain tourism communities begin to push each other to the limits in environmentally responsible management initiatives.

This trend is proving especially influential in Whistler, where environmental efforts are starting to receive top priority. The RMOW is among those organisations recognising the escalating role of environmentally responsible management and operations in strategic destination positioning. The RMOW is currently illustrating this recognition through its development of the *Whistler Environmental Strategy*, an approach in a class of its own among mountain resort community environmental efforts. Without the added motivation of desiring Whistler to be among the environmental leaders in mountain resort communities, it is unlikely that critical stakeholders such as the RMOW and Whistler/Blackcomb would have provided the considerable support and involvement that they did towards the development of the CCWMP. As stated by the environmental resource manager of Whistler/Blackcomb, "protecting the environment is one of the cornerstones in making Whistler a great resort over the long term. We are trying to do a better job than any other resort in the world when it comes to environmental stewardship…" (Damaske 1999).

Delivering the Image

More significantly than providing Whistler with a competitive marketing edge among other mountain resorts, environmental management initiatives such as the CCWMP will effectively help protect the integrity of the natural landscape that has largely been the foundation of Whistler's success. Tourism operators constantly capitalise on Whistler' natural beauty, publishing endless glossy images of forested snowy mountains, sparkling lakes and rivers, and clear blue skies. Environmental initiatives such as watershed management planning can *deliver* that image by helping to maintain and protect the actual quality of that natural environment. The marketing advantage of a beautiful natural environment can only be lastingly effective if the reality consistently matches the image.

5.4 UNIQUE CHALLENGES

Just as unique opportunities have been identified regarding the Crabapple Creek watershed management planning process, unique challenges may also be distinguished. This section discusses some of these challenges as part of the evaluation of the Crabapple Creek watershed experience in relation to other recent watershed management planning initiatives.

5.4 1 WATERSHED RESIDENT INVOLVEMENT: IS ANYBODY HOME?

During the development of the CCWMP, achieving the participation of critical watershed land users and decision makers in the process was relatively straightforward. However, engaging watershed residents with no affiliation to any of the larger stakeholder groups proved to be a much more challenging task. The various means employed to attract the involvement of watershed residents in the planning process (i.e. the information brochure distributed to residents and articles in local newspapers) were less than successful, resulting only in one telephone inquiry to the project Coordinator. While these communicative measures likely increased community awareness of watershed issues and the development of the watershed management plan for Crabapple Creek, they fell short of inducing much participation by watershed residents who were not already members of the existing key stakeholder groups. Reasons for the difficulty in involving watershed residents may in part be attributed to the unusual population demographics of Whistler. A significant portion of the community is comprised of seasonal residents, who may have been absent during the summer of 1999 when the Crabapple Creek watershed management planning initiative began.

Second home owners comprise a unique category of resident in Whistler, a trait common to many mountain resort communities (Williamson 1992). In Whistler, the number of second home owners is approximately 8000 in addition to the full time resident population of 9600 (Laing 2000). These second home owners occupy their Whistler residences mainly during the winter season, often leaving them unoccupied for the remainder of the year or leasing them out on a short-term basis.

As shown in part by the substantive number of second home owners, the Whistler community houses a somewhat transient population. Whistler residents, like those in most mountain resort communities, may be differentiated in relation to their degree of permanence as community residents. The most transient population segment includes seasonal workers, who predominantly work for Whistler/Blackcomb in the winter season, from November to April. In addition to the full time resident and second home owner population, the number of seasonal employees in Whistler each year is approximately 3000 (Laing 2000).

Given the unusual nature of Whistler's population, it is not entirely surprising that efforts to involve watershed residents in the development of the CCWMP were not especially effective. The Pique, a local Whistler newspaper, recently featured another article about the CCWMP in February 2000. The article drew attention to the CCWMP's presence at RMOW Municipal Hall, available for public review and comment. It is hoped that, due to its publication during the height of the winter season, this article has reached many watershed residents and community members who may have been absent during the summer. Additionally, it is hoped that they will subsequently be encouraged by the article to learn more about and participate in further Crabapple Creek watershed management initiatives or other stewardship activities within Whistler.

5.4.2 A DIFFERENT KIND OF DEVELOPMENT

Most communities embarking on watershed management planning initiatives have similar development issues to consider. Urban watershed concerns such as degraded riparian integrity and increased impervious area due to urbanisation are commonplace in the realm of watershed management planning. However, as revealed by the Crabapple Creek watershed management planning experience, Whistler presents some unique development issues related to the tourism-based nature of the resort community, in addition to many of the more familiar concerns. While offering unique opportunities with regards to influential stakeholder involvement and support, the presence of a world class ski area and a

championship golf course within the Crabapple Creek watershed also presents unique challenges with regards to restoring and protecting the ecological integrity of the watershed.

This challenge has already been faced by Whistler/Blackcomb, as innovative measures were employed during an expansion project within the headwaters of Crabapple Creek on Whistler Mountain. The construction of the new Garbonzo chairlift and several new ski runs was conducted during the summer and fall of 1999. During this period, a key representative from Whistler/Blackcomb was involved in the development of the CCWMP. Holding a senior position in mountain planning and operations, this individual was able to guide the planning and construction of this project towards protecting the integrity of Crabapple Creek. Minimal timber was extracted from the project site, and all identified old growth stands were left intact, recognising the importance of riparian integrity to the health of the stream system. Heli-logging was the primary method used to clear a passage for the lift line, so as not to require road building or disturbance of the forest understory. Instead of the traditional "clearcut" style of ski runs, gladed runs with partial forest cover and a minimum width of 50m were developed to incur minimal ecological and hydrologic impact. These innovative measures taken by Whistler/Blackcomb demonstrate a commitment to achieving the objectives of the CCWMP. In addition, they help to illustrate some of the unique measures required for effective watershed management in the mountain resort community of Whistler.

During the summer of 2000, the Whistler Golf Course plans to renovate the first nine holes of the course, located adjacent to the main stem of Crabapple Creek. This project will pose some unique challenges to watershed management in Whistler's Crabapple Creek. A difficult balance must be achieved between maintaining the recreational function of the golf course and protecting the ecological integrity of Crabapple Creek's lower reaches, which provide vital spawning and rearing habitat for fish. A key stakeholder in the development of the CCWMP, the Whistler Golf Course is aware that some innovative solutions may be required to effectively achieve this balance.

In addition to facing obstacles common to other communities conducting watershed management initiatives, the Crabapple Creek experience reveals other unique challenges related to the tourism-based resort nature of Whistler. Another unique challenge facing effective watershed management in Crabapple Creek is the potential for increased development pressure due to the escalated cost of real estate in Whistler. The implementation of the CCWMP addresses this issue by placing restrictions on impervious area levels and riparian area development. It remains to be seen how well stakeholder commitment and implementation of the CCWMP will stand the test of time – and of tourism. It is hoped, however, that the CCWMP is the beginning of a trend in Whistler that places ecological integrity on equal footing with economic expansion, advancing the resort community towards true sustainability.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

This chapter discusses the current status of the Crabapple Creek Watershed Management Plan. A brief evaluation of the Crabapple Creek Watershed Management Plan is presented, relating to how effectively it addresses the critical features of integrated watershed management plans as outlined in Chapter Two. A summary of the unique features of the plan related to the tourism-based nature of Whistler is also provided. This chapter concludes with recommendations for further research and some final remarks.

6.1 CURRENT STATUS OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The CCWMP will be submitted in May 2000 to the RMOW Council for approval as a guiding policy document for the Crabapple Creek watershed. A public unveiling of the CCWMP will coincide with Arbour Day 2000 activities. It is hoped that the recommendations for implementation, as outlined in section 4.3.7, will be carried out and that suggested policy changes will occur in a timely manner. It is likely that consideration of the *Whistler Environmental Strategy* by RMOW Council will affect how quickly and in what form implementation of the CCWMP occurs.

Although the CCWMP is not yet approved as a formal RMOW guiding document, key stakeholders involved in the development process are committed to implementing as much of the plan as possible. Some interpretive signs have already been erected by Whistler/Blackcomb on Whistler Mountain and riparian planting in areas recommended by the CCWMP has been planned for late spring 2000 by the WFSG and the RMOW Parks and Recreation Department. As Tourism Whistler prepares to conduct significant design modifications to the first nine holes of the Whistler Golf Course, recent WFSG meetings suggest that there is a strong desire among stakeholders to incorporate the recommendations of the CCWMP related to this site. The CCWMP development process is already proving

effective, as stakeholders are beginning to fulfil their responsibilities in advance of any formal municipal regulation.

6.2 AN EVALUATION OF THE CCWMP

In Chapter Two, a review of relevant literature identified various critical features of effective integrated watershed management plans. This section presents a brief personal and subjective evaluation of the CCWMP according to how effectively it has incorporated these features. **Table 3** summarises this evaluation, rating the incorporation of critical features into the CCWMP as either good, satisfactory, or inadequate.

Watershed Scale

Experts have advocated that management plans are most effective when developed for watersheds ranging from 1-15 square miles or 10-200 square kilometres. With an area of 4.8km^2, the Crabapple Creek watershed lies at the smaller end of the preferred management size spectrum. However, due to its location in the relatively small mountain community of Whistler, the Crabapple Creek watershed was perceived by key stakeholders as an appropriate scale for effective local planning, management and decision making.

Plan Structure and Components: Vision, Objectives and Actions

The CCWMP is clear in its statement of a vision, objectives and actions for the Crabapple Creek watershed. The vision for the watershed was developed by key stakeholders and serves as the overriding aim of the CCWMP. Four central Objectives were established, each accompanied by a series of Recommendations (action items) addressing the main issues within the Crabapple Creek watershed.

Plan Structure and Components: Monitoring

Currently, relatively little is known about the ecological condition of the Crabapple Creek watershed. As such, the CCWMP clearly highlights monitoring as a key component of

effective watershed management. The CCWMP proposes a broad range of important monitoring programs and indicators aimed at measuring both biophysical changes within the watershed and progress towards fulfilling the Objectives of the plan.

Plan Structure and Components: Implementation

The CCWMP recommends the creation of two committees to oversee implementation of the plan. The Crabapple Creek Watershed Management Committee, comprised of key stakeholders, will meet periodically to discuss changing watershed conditions and progress in completing the Recommendations of the CCWMP. This committee will be responsible for amending the plan according to need. The CCWMP is intended as a living document, adaptable to the efficacy/inefficacy of selected management strategies, changes in watershed conditions, and the evolution of stakeholder values.

A secondary group entitled the Crabapple Creek Watershed Management Plan Implementation Team will be responsible for implementing the various legislative changes recommended by the CCWMP. This Implementation Team will formulate appropriate policy amendments to assist in the fulfilment of the CCWMP Objectives.

The CCWMP also proposes the signing of Memorandums of Understanding among key watershed stakeholders to more formally acknowledge their commitment to achieving the Vision and Objectives of the CCWMP.

Plan Structure and Components: Budget

The CCWMP does not include a budget to facilitate the plan's implementation. This is the most obvious shortcoming of the CCWMP, as a budget is a fundamental component to any effective watershed management planning initiative. Reasons for this omission include: the relatively short time frame of the CCWMP development process; a lack of both time and willingness on the part of key stakeholders to submit estimates of various action item costs;

the broad and ongoing nature of many of the plan's Recommendations; and a lack of costing experience on the part of the project Coordinator.

Plan Structure and Components: Public Education

The CCWMP more than adequately addresses the need for public education in integrated watershed management initiatives. The primary Objective of the CCWMP and its accompanying Recommendations aim to encourage watershed education, mindfulness and stewardship on the part of community government, residents and visitors. The *Crabapple Creek Interpretive Strategy* proposes a series of initiatives intended to enhance learning about the Crabapple Creek watershed and watershed issues in general.

Plan Structure and Components: Size and Simplicity

While the length of the CCWMP is not excessive, the size of the plan could be reduced by condensing the extensive background information provided about the Crabapple Creek watershed. A brief summary of watershed conditions would likely suffice. However, detailed information was provided in order to introduce stakeholders to the conditions and issues of the watershed. Enough information was provided to allow the stakeholders to participate in reviewing the CCWMP without requiring them to perform additional research. The CCWMP is not an overly complex or technical document, reflecting the broad targeted audience of all watershed stakeholders and community members.

Stakeholder Involvement

Key watershed stakeholders were involved in the development of the CCWMP. They participated in ongoing dialogues facilitated by the project Coordinator. However, engaging watershed residents with no affiliations to those larger groups proved to be a much more difficult task. It is hoped that future inclusive watershed management initiatives in Whistler learn from the challenges of the Crabapple Creek experience and that managers will apply creativity and resourcefulness in their efforts to solicit community participation.

Biophysical Issues: Riparian Areas

The second Objective of the CCWMP addresses the importance of riparian integrity to overall watershed health. The Recommendations that accompany this Objective sufficiently acknowledge the need to restore and protect riparian areas in order to maintain the ecological integrity of Crabapple Creek. Suggested CCWMP monitoring indicators also recognise riparian area integrity as a necessary condition to watershed health.

Biophysical Issues: Impervious Areas

The third Objective of the CCWMP and its accompanying Recommendations emphasise the relation of impervious area to the hydrologic conditions and characteristics of the watershed. In its management strategies and proposed monitoring program, the CCWMP clearly acknowledges impervious area as an important indicator of overall watershed health. This is an especially significant issue for the Crabapple Creek watershed, as the total impervious area now lies in a healthy range. Restricting an increase in the current level of imperviousness in the face of future potential pressures will play a critical role in the effectiveness of various other watershed management strategies.

Biophysical Issues: Stream and Watershed Restoration

The Recommendations complementing Objectives 3 and 4 demonstrate that the CCWMP successfully emphasises the importance of an ecosystem approach to stream and watershed restoration. As a whole, the CCWMP aims to decrease or eliminate many of the causes of stream and watershed degradation. The CCWMP also advocates that specific stream restoration projects address the sources of problems and not merely attempt to mitigate the negative effects.

Biophysical Issues: Stormwater Management

Although the Crabapple Creek watershed is only moderately urbanised, the CCWMP incorporates various facets of integrated stormwater and stream corridor management. These management forms, largely rooted in engineering, are usually applied to more heavily urbanised watersheds. The Crabapple Creek watershed does, however, present some common challenges relating to the adaptation of traditional engineering tactics towards more ecologically sound practices. The CCWMP addresses these challenges through various Recommendations, such as restricting an increase in impervious area and establishing protective riparian areas. As a model for future watershed management initiatives in Whistler, the CCWMP introduces important aspects of stormwater management and best engineering practices for maintaining the integrity of streams in developed areas.

Table 3 Summary evaluation of the Crabapple Creek Watershed Management Plan according to the incorporation of identified critical features

	GOOD	**SATISFACTORY**	**INADEQUATE**
WATERSHED SCALE	✔		
PLAN STRUCTURE AND COMPONENTS			
Vision, Objectives, Actions	✔		
Monitoring	✔		
Implementation	✔		
Budget			✔
Public Education	✔		
Size and Simplicity		✔	
STAKEHOLDER INVOLVEMENT		✔	
BIOPHYSICAL ISSUES			
Riparian Areas	✔		
Impervious Areas	✔		
Stream and Watershed Restoration	✔		

Stormwater Management	✔		

6.3 UNIQUE PLANNING FOR UNIQUE PLACES

The Crabapple Creek case study describes the development of an integrated watershed management plan in a mountain resort community. Intrinsically linked to the tourism-based nature of Whistler, the Crabapple Creek watershed management planning experience demonstrates a distinctive focus on encouraging mindfulness and stewardship through management and interpretive initiatives. The Objectives and Recommendations of the CCWMP emphasise learning and involvement on the part of watershed residents and visitors as an important means of protecting the integrity of Crabapple Creek. The CCWMP emphasises the conviction that mindful watershed stakeholders are essential to the sustained ecological health of Crabapple Creek.

The Crabapple Creek watershed management planning process reveals some unique opportunities intrinsically related to the resort character of the Whistler community. The conception of the *Whistler Environmental Strategy* has opened the door for potentially meaningful RMOW action regarding environmental issues. This movement towards environmental sustainability, led by the *Whistler Environmental Strategy*, significantly facilitated the development of the CCWMP. The prior existence of the Whistler Fisheries Stewardship Group, a partnership among key watershed stakeholders, contributed greatly to the level and quality of participation in the CCWMP development process by key stakeholders. The commitment of key stakeholders to the Objectives of the CCWMP would not be as strong without their previous interest and involvement in watershed issues gained through the WFSG. The prominence of outdoor recreational activities in Whistler also provides exceptional opportunities for fostering environmental learning. The CCWMP capitalises on the inclination of Whistler's residents and visitors towards the outdoors. The *Crabapple Creek Interpretive Strategy* encourages learning, mindfulness and stewardship among watershed residents and visitors. It is hoped that these rare opportunities will assist

in future watershed management efforts within Whistler and other mountain resort communities.

In addition to unique opportunities, the tourism-based nature of the Whistler community has also presented some unique challenges for the Crabapple Creek watershed management planning initiative. The unusual nature of the resort community's population demographics posed great difficulty to engaging watershed residents in the development process of the management plan. The exceptional degree of recreational development, including a world class ski hill and a championship golf course, also presents some unusual challenges for watershed management in the Crabapple Creek watershed. Innovative tactics are being employed as critical land users and decision makers strive to meet this challenge and work towards restoring and protecting the ecological integrity of Crabapple Creek. It is hoped that the recognition of these challenges will prove useful in developing future watershed management planning initiatives throughout the Whistler Valley.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

The implications of the CCWMP for enhanced environmental stewardship and effective watershed management in Whistler are yet to be determined. As promising as it may seem on paper, the true test of the CCWMP's effectiveness will take time to ascertain. Indeed, the efficacy of the CCWMP will have to be measured at many levels. Changes in the ecological condition of the watershed over time will help determine the efficacy of various biophysical Recommendations. The modification of municipal policy will help determine the strength of the CCWMP in bringing about legislative watershed protection measures. Both of these areas are suggested for future research, as the efficacy of watershed management planning cannot be determined without such evaluations.

Another important question for further research includes the effectiveness of CCWMP management strategies in fostering environmental learning. An assessment of the impact of the Crabapple Creek Interpretive Strategy, once implemented, on achieving mindfulness among residents and visitors would be of great interest to many stakeholders. This

assessment could be conducted by a survey distributed at strategic locations throughout the watershed. From a tourism perspective, it would be worthy to investigate the benefits, if any, of the *Crabapple Creek Interpretive Strategy* to watershed visitors engaged in outdoor recreation activities.

Other important questions for future research include:

- what is the level of satisfaction key watershed stakeholders experienced with the CCWMP development process?;
- how might the inclusion of Whistler watershed residents in watershed management initiatives be improved?;
- how might stronger partnerships facilitating the fiscal investment needed for effective watershed management in Whistler be developed?; and
- what are some reasons why significant environmental initiatives taking place in Whistler, such as the development of the *Whistler Environmental Strategy* and the Crabapple Creek Watershed Management Plan, are not more widely advertised by Tourism Whistler, the primary marketing agency for the resort community?

6.5 FINAL REMARKS

In providing a potential framework for integrated watershed management planning, the Crabapple Creek Watershed Management Plan is designed to advance the effectiveness of watershed management initiatives not only in Whistler but throughout the province. As the practice of integrated watershed management in British Columbia is relatively new, all such initiatives play a significant role in demonstrating a variety of approaches to similar concerns. As managers learn from the experiences of others, they will undoubtedly become more proficient in bringing about effective watershed planning, management and restoration at the local and regional scales. Over time, the efficacy of these differing approaches will become more apparent, facilitating the process and escalating the overall health of British Columbian watersheds.

The Crabapple Creek watershed management planning experience may also serve as an example for North American mountain resort communities. Watershed management planning will likely become the norm in these areas, due largely to recent changes in US government requirements for ski area environmental conduct. However, it is unknown how well integrated these efforts will be with surrounding land use management initiatives. Facing similar challenges and opportunities presented by the mountain resort nature of their watershed environments, these resort communities may learn from the Crabapple Creek experience and work towards more effectively protecting their valued watersheds through integrated planning initiatives.

The Crabapple Creek Watershed Management Plan emphasises the importance of a watershed approach to the protection and restoration of our local streams. Just as the protection of headwater tributaries helps preserve the valuable fish habitat of Crabapple Creek's lower reaches, the protection of Crabapple Creek helps to preserve the ecological integrity of the stream it flows into, the River of Golden Dreams. The Crabapple Creek Watershed Management Plan, just like Crabapple Creek itself, is simply a sub-component of a larger framework. The positive effects of stewardship in the Crabapple Creek watershed, guided in part by the Crabapple Creek Watershed Management Plan, become part of the larger river continuum and will continue to flow downstream from system to system. In this way, the Crabapple Creek Watershed Management Plan is a notable step towards protecting other water resources in the Whistler Valley and beyond.

It was my deepest honour to be involved with development of such an important initiative in Whistler, an honour and an experience that I will take with me wherever my personal path should meander. I hope to see the movement towards environmental sustainability in Whistler continue with all the momentum of the Crabapple Creek initiative and more.

APPENDIX A

Crabapple Creek Watershed Management Plan Stakeholder Questionnaire

This questionnaire is meant to aid in the development of a Vision and Objectives for the Crabapple Creek Watershed Management Plan. Please be as thorough as possible in your responses and feel free to respond on separate pieces of paper if you require more writing space.

1. With respect to an overall Vision for the Crabapple Creek watershed, what type of inclusion would you consider to be central to this statement? (For example, 'ecosystem health', community health', 'community awareness', or 'future generations', or 'guiding future development'.)
2. What do you feel are the most significant positive issues relating to the Crabapple Creek watershed? (For example, 'central location within Whistler valley', 'good community interest', or 'thriving fish populations'.)
3. What do you feel are the most significant negative issues or problems facing the Crabapple Creek watershed? (This might range from large scale issues such as 'future development' or 'lack of community awareness', or may be as specific as 'sedimentation in the creek' or 'lack of hydraulic diversity'.)
4. Linked to your responses to question 3, what potential factors do you feel might be contributing to these concerns?
5. Linked to your responses to questions 3 and 4, please list any suggestions you might have for potential solutions to these negative concerns.
6. Do you think it would be effective to create an ongoing 'Task Force' type of committee to oversee future implementation and monitoring of the Crabapple Creek Watershed Management Plan? Would you be interested in participating as a member of such a committee if one were to be created?
7. Please expand on any questions, concerns or comments related to the development or content of the Crabapple Creek Watershed Management Plan.

APPENDIX B

Stream Restoration Project Guidelines

Some useful guidelines for stream restoration projects as proposed by Newbury and Gaboury (1994) are as follows:

1. Define drainage basin on maps.
2. Draw longitudinal stream profile to illustrate elevation changes.
3. Examine flow records (flood frequency, minimum and peak discharges).
4. Identify sample reaches and conduct a detailed survey (channel size and shape, drainage area, bankfull discharge).
5. Complete a detailed survey (specific problems and site characteristics).
6. Examine undisturbed reference areas and identify riparian and hydrologic conditions to replicate (natural pool/riffle/meander systems). This will help ensure that restoration designs will be reinforced by the stream system and not undermined.
7. Prepare a detailed restoration design, replacing natural conditions and structures within the stream to match the energy of flood flows.
8. Test the restoration against the stream's seasonal flow variability.
9. Construct the restoration project with careful supervision to ensure minimal habitat disturbance.
10. Monitor and evaluate. Make adjustments over time if needed.

REFERENCES

Arnold, C.L. and C.J. Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. *Journal of the American Planning Association* Spring: 243-258.

Beresford, H. February 2000. Personal communication with environmental supervisor, Parks and Recreation Department, Resort Municipality of Whistler.

Beresford, H. May – December 1999. Personal communication with environmental supervisor, Parks and Recreation Department, Resort Municipality of Whistler.

Biggs. C.C. and C.Z. Roth. 1986. Interpreting the river resource. *Journal of Interpretation* 11 (2): 49-56.

Bisson, P.A., T.P. Quinn, G.H. Reeves and S.V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest River Systems, pp. 189-232. In *Watershed Management: Balancing Sustainability and Environmental Change*, edited by Naiman, R.J. New York, NY: Springer-Verlag.

Black, P.E. 1999. Putting the people in watershed management. *Water Resources Impact* 1 (1): 5-6.

Booth, D.B. 1990. Stream-channel incision following drainage-basin urbanisation. *Water Resources Bulletin* 26 (3): 407-417.

Bowers, J.L. 1999. Watershed management: it's not just a job, it's a way of life. *Water Resources Impact* 1 (1): 1111-13.

British Columbia Environment and British Columbia Ministry of Forests. 1991. *Pemberton Creek Integrated Watershed Management Plan*. Victoria.

British Columbia Ministry of Environment. 1988. *Oyster River Water Management Plan*. Victoria: Vancouver Island Region and Planning and Assessment Branch.

British Columbia Ministry of Environment, Lands and Parks. 1993. *Namaimo River Water Management Plan*. Victoria: Vancouver Island Region, Regional Water Management.

British Columbia Ministry of Environment, Lands and Parks and British Columbia Ministry of Affairs and Housing. 1997. Streamside protection under the Fish Protection Act:

The role of local government workshop. Workshop guide, part 2 of 3, December 4. Richmond, BC.

British Columbia Ministry of Municipal Affairs. 1998. *New Tools for Environmental Stewardship in the Municipal Act: Local Government Statutes Amendment Act, 1997 – Bill 26*. Victoria, BC.

Brouha, P. and W. Chappell. 1997. A watershed call to arms: they've paved paradise and put up a parking lot. *Fisheries* 22 (5): 4-5.

Cantwell, M. and J.C. Day. 1996. Walking the walk or just talking the talk? Government support for integrated watershed management at the local level. In *Watercourses: Getting on Stream with Current Thinking*, edited by R. Hicks, proceedings of a conference organised by the British Columbia Branch of the Canadian Water Resources Association, Vancouver, BC, 23-24 October, 1996. Cambridge, ON: Canadian Water Resources Association.

Center for Watershed Protection. 1998a. *Rapid Watershed Planning Handbook: A Comprehensive Guide for Managing Urbanizing Watersheds.* Elliot City, MD: US Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V.

Center for Watershed Protection. 1998b. *Better Site Deign: A Handbook for Changing Development Rules in Your Community*. Elliott City, MD: Site Planning Roundtable.

Charlton, D.L. and Tufgar, R. 1991. Integrated watershed management approach for small southern Ontario rural/urban watersheds. *Canadian Water Resources Journal* 16 (4): 421-432.

Chillibeck, B., G. Chislett and G. Norris. 1993. *Land Development Guidelines for the Protection of Aquatic Habitat*. Vancouver, BC: Fisheries and Oceans Canada and British Columbia Ministry of Environment, Lands and Parks.

City of Aspen. 1993. *Aspen Area Community Plan*. Aspen, CO.

Claytor, R.A. and W.E. Brown. 1996. *Environmental Indicators to Assess Stormwater Control Programs and Practices – Final Report*. Silver Spring, MD: Center for Watershed Protection.

Craigflower Watershed Management Forum. August 1998. *Craigflower Watershed Management Plan*. Capital Regional District, BC.

Culp. J.M., K.J. Cash and D.B. Halliwell. 1997. *Volunteer-Based Monitoring Program for the Salmon River Basin: Using Benthic Indicators to Assess Stream Ecosystem Health*. Saskatoon, SK: National Hydrology Research Institute, Environment Canada.

Curran, D. 1999. *Environmental Stewardship and Complete Communities: A Report on Municipal Environmental Initiatives in British Columbia 1999*. Report Series R99-6 (April 1999). Victoria, BC: Eco-Research Chair of Environmental Law and Policy, Faculty of Law and School of Environmental Studies, University of British Columbia.

Damaske, K. 1999. Whistler – When is a clearcut not a clearcut? When it's a ski run. *The Sea to Sky Voice* Friday, July 12. Whistler: BC.

Department of Fisheries and Oceans Canada. 1994. *Stream Stewardship: A Guide for Planners and Developers*. Vancouver, BC: Department of Fisheries and Oceans Canada and British Columbia Ministry of Environment, Lands and Parks.

Dorward, S. 1990. *Design for Mountain Communities: A Landscape and Architectural Guide*. New York, NY: Van Nostrand Reinhold.

EBA Engineering Consultants and British Columbia Ministry of Energy, Mines and Petroleum Resources. January 1992. Mineral Resource Division, Geological Survey Branch. Minfile 092J Pemberton Mapsheet.

Economic and Engineering Services, Inc. 1999. *Guide to Watershed Planning and Management: A Manual to Assist Washington's Local Governments and Tribes with Watershed Planning and Management Under the Watershed Management Act (RWC 90.82/ESHB 2514)*. Olympia, WA: Washington Department of Ecology.

Emery, E., B. Derry, K. Stephens, and C. Baisley. 1998. Implications for integrated watershed management planning in a west coast urban environment: City of Surrey case study. In *Mountains to Sea: Human Interaction with the Hydrologic Cycle*, edited by Y. Alila, proceedings of the CWRA 51st Annual Conference, Victoria, BC, 10-12 June, 1998. Cambridge, ON: Canadian Water Resources Association.

Epstein Jayaratne, T. and A.J. Stewart. 1991. Quantitative and qualitative methods in the social sciences: current feminist issues and practical strategies. In *Beyond*

Methodology: Feminist Scholarship as Lived Research, edited by M.M. Fonow and J. Cook. Indianapolis: Indiana University Press.

Fraser Basin Council. 1997. *Charter for Sustainability*. Vancouver, BC: Fraser Basin Management Program.

Giannico, G.R. and M.C. Healey. 1998. *Integrated Management Plan for a Suburban Watershed: Protecting Fisheries Resources in the Salmon River, Langley, British Columbia*. Canadian Technical Report of Fisheries and Aquatic Sciences 2203. Vancouver, BC: Fisheries and Oceans Canada.

Gibson, H. 1998. The educational tourist. *Journal of Physical education, Recreation and Dance* 69 (4): 6-8.

Gill, A. and P. Williams. 1994. Managing growth in mountain tourism communities. *Tourism Management* 15 (3): 212-220.

Harbor, J. 1994. A practical method for estimating the impact of land use change on surface runoff, groundwater recharge and wetland hydrology. *Journal of the American Planning Association* Winter: 95-108.

Hawkes, S. 1993. The "greening" of Canadian Pacific Hotels and Resorts: the Chateau Whistler case. In *The Greening of Tourism: From Principles to Practice*, edited by S. Hawkes and P. Williams. Burnaby, BC: Centre for Tourism Policy and Research, Simon Fraser University.

Hawkes, S. and P. Williams. 1993. *The Greening of Tourism: From Principles to Practice.* Burnaby, BC: Centre for Tourism Policy and Research, Simon Fraser University.

Houston, J. August 1999. Report: impervious area of the Crabapple Creek watershed. Data collection and analysis. Vancouver, BC: University of British Columbia.

Inskeep, E. 1991. *Tourism Planning: An integrated and sustainable development approach*. New York: Van Nostrand Reinhold.

Jamieson, M. 1996. Watershed plans: from backwater to mainstream. In *Watercourses: Getting on Stream with Current Thinking*, edited by R. Hicks, proceedings of a conference organised by the British Columbia Branch of the Canadian Water Resources Association, Vancouver, 23-24 October, 1996. Cambridge, ON: Canadian Water Resources Association.

Kauffman, J.B., R.L. Beschta, N. Otting and D. Lytjen. 1997. An ecological perspective of riparian and stream restoration in the western United States. *Fisheries* 22 (5): 12-24.

Kerr Wood Leidal Associates Ltd. January 1982. International Land Corporation Ltd.: Pre Design Report on Stormwater Control for DL 4751 at Whistler. Vancouver, BC.

Kerr Wood Leidal Associates Ltd. September 1990. Blueberry Hill at Whistler: Report on Stormwater Management. Whistler, BC: Resort Municipality of Whistler.

Krzesinska, L. September 1995. River of Golden Dreams and Crabapple Creek Stream Survey Report. Whistler, BC: Resort Municipality of Whistler.

Krzesinska, L. September 1996. 1996 Fish and Stream Habitat Program, Crabapple Creek. Whistler, BC: Resort Municipality of Whistler.

Laing, C. February 2000. Personal communication with planning technician, Planning Department, Resort Municipality of Whistler.

Lane, B. 1991. Sustainable tourism: a new concept for the interpreter. *Interpretation Journal* 49: 1-4.

Langer, E.J. 1989. *Mindfulness*. Don Mills, ON: Addison-Wesley Publishing Company, Inc.

Leopold, L. 1968. Hydrology for urban land use planning: a guidebook on the hydrologic effects of urban land use. *U.S. Geological Survey Circ*., No. 554.

Leslie, D. 1998. 'The environment matters' conference: education as a key factor in the tourism-environment nexus. *Journal of Sustainable Tourism* 6 (4): 339-342.

Litke, S. and J.C. Day. 1998. Building local capacity for stewardship and sustainability: the role of community-based watershed management in Chilliwack, British Columbia. *Environments* 25 (2 & 3): 91-109.

Malanson, G. 1993. *Riparian Landscapes*. Cambridge University Press: Cambridge.

Millar, J., N. Page, M. Farrel, B. Chillibeck, and M. Child. 1997. *Establishing fisheries management and reserve zones in settled areas of coastal British Columbia*. Vancouver, BC: Department of Fisheries and Oceans Canada.

Millard/Piercy Watershed Stewards. 1999. *Millard/Piercy Watershed Management Plan.* Courtenay, BC.

Moscardo, G. 1992. The tourist-resident distinction: implications for the management of museums and other interpretive settings. *The Journal of Tourism Studies* 3 (2): 2-19.

Moscardo, G. 1996a. Principles for effective interpretation: what have we learnt from 100 years of presenting heritage to visitors. In *Interpretation in Action*, proceedings from the Fifth Annual Interpretation Australia Association Conference, Bendigo, Australia, 30 November-3 December, 1996. Collingwood, Victoria: Interpretation Australia Association.

Moscardo, G. 1996b. Mindful visitors: heritage and tourism. *Annals of Tourism Research* 23 (2): 3760397.

Moscardo, G. and P.L. Pearce. 1986. Visitor centres and environmental interpretation. *Journal of Environmental Psychology* 6: 89-108.

Mountain Agenda. 1998. *Mountains of the World: Water Towers for the 21st Century*, 1998 Spring Session on "Strategic Approaches to Freshwater Management". Berne, Switzerland: Commission on Sustainable Development.

Neuman, R. and G. Fox. June 1980. Crabapple Creek (Whistler). Reconnaissance. Whistler, BC.

Newbury, R.W. and M.N. Gaboury. 1994. *Stream Analysis and Fish Habitat Design: Field Manual*. Gibsons, BC: Newbury Hydraulics.

Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources. 1993a. *Subwatershed Planning*. Toronto, ON: Queen's printer.

Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources. 1993b. *Integrating Water Management Objectives into Municipal Planning Documents*. Toronto, ON: Queen's printer.

Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources. 1994. *Water Management on a Watershed Basis: Implementing an Ecosystem Approach*. Toronto, ON: Queen's printer.

Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources. 1997. *Inventory of Watershed Management Projects in Ontario, 1990-1995.* Toronto, ON.

Quadra Planning Consultants Ltd. 1995. *Protection of Aquatic and Riparian Habitat by Local Governments: An Inventory of Measures Adopted in the Lower Fraser Valley, 1995*. Vancouver, BC: Fisheries and Oceans Canada and Environment Canada.

Reeves, G.H., J.D. Hall, T.D. Roelofs, T.L. Hickman and C.O. Baker. 1991. Rehabilitating and modifying stream habitats, pp. 519-557. In *Influences of forest and rangeland management on salmonid fishes and their habitats*, special publication 19, edited by Meehan, W.R. Bethesda, MY: American Fisheries Society.

Resort Municipality of Whistler. 1996. *Annual Community and Resort Monitoring Program Report*. Whistler, BC: Department of Planning and Development.

Resort Municipality of Whistler. 1997. *Whistler Community and Resort Profile*. Whistler, BC: Department of Planning and Development.

Richter, K.G. and G.A. Schultz. 1990. Aggravation of flood conditions due to increased industrialization and urbanization. In *Hydrological Processes and Water Management in Urban Areas*, edited by H. Massing, J. Packman and F.C. Zuidema, proceedings of the International Symposium, Duisburg, West Germany, 24-29 April, 1988. Oxforsdshire, UK: International Association of Hydrological Sciences.

Riley, A.L. 1998. *Restoring Streams in Cities: A Guide for Planners, Policy Makers, and Citizens*. Covelo, CA: Island Press.

Romaine, M.J. 1996. An emerging model for future watershed management in British Columbia. In *Watercourses: Getting on Stream with Current Thinking*, edited by R. Hicks, proceedings of a conference organised by the British Columbia Branch of the Canadian Water Resources Association, Vancouver, BC, 23-24 October, 1996. Cambridge, ON: Canadian Water Resources Association.

Roper, B., J. Dose and J. Williams. 1997. Stream restoration: is fisheries biology enough? *Fisheries* 22 (5): 6-11.

Royal Commission on the Future of the Toronto Waterfront. 1990. *Watershed: Interim Report August 1990*.

Salmon River Watershed Partnership. 1998. *Salmon River Watershed Management Plan*. Langley, BC.

Schreier, H., K. Hall, S. Brown, L. Lavkulich and P. Zandbergen. 1997. *Integrated Watershed Management*. CD-ROM. Vancouver, BC: Institute for Resources and Environment, University of British Columbia.

Schueler, T.R. 1994a. The importance of imperviousness. *Watershed Protection Techniques* 1 (3): 100-111.

Schueler, T.R. 1994b. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs.* Silver Spring, MD: Center for Watershed Protection for the Department of Environmental Programs, Metropolitan Washington Council of Governments.

Schueler, T.R. 1995a. *Site Planning for Urban Stream Protection*. Silver Spring, MD: The Center for Watershed Protection.

Schueler, T.R. 1995b. Crafting better urban watershed protection plans. *Watershed Protection Techniques* 2 (2): 33-42.

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound. April 1995. *Report 5: Sustainable Ecosystem Management in Clayoquot Sound: Planning and Practices.* Victoria, BC: Clayoquot Scientific Panel.

Sharpe, G.W. (ed.). 1976. *Interpreting the Environment.* New York: John Wiley and Sons.

Sharpe, G.W. and G.L. Gensler. 1978. Interpretation as a management tool. *Journal of Interpretation* 3 (2): 3-9.

Sherman, H. and B. Barret. 1998. Watershed management: coming soon to a wetlands near you. *Ski Area Management* 37 (3): 60-64, 112.

Stephens, K. 1999. Implementing ecosystem-based stormwater management in B.C. In *Integrated Stormwater and Stream Corridor Management: Balancing Challenges and Opportunities at the Community Level*. Vancouver, BC: Environment Canada, Fisheries and Oceans Canada, and British Columbia Ministry of Environment, Lands and Parks.

Stewart, E.J., B.M. Hayward and P.J. Devlin. 1998. The "place" of interpretation: a new approach to the evaluation of interpretation. *Tourism Management* 19 (3): 257-266.

Still Creek-Brunette Basin Work Group. August 1996. *Still Creek-Brunette Basin Issues and Proposed Actions*. Draft report. Burnaby, BC: Still Creek-Brunette Basin Work Group.

Stoney Creek Stormwater Steering Committee. December 1998. *Integrated Stormwater Management Strategy for Stoney Creek Watershed*. Revised draft for final review. Vancouver, BC: Kerr Wood Leidal-CH2M Hill Inc.

Taccogna, G. and K. Munro (eds.). 1995. *The Streamkeepers Handbook: A Practical Guide to Stream and Wetland Care*. Vancouver, BC: Salmonid Enhancement Program, Department of Fisheries and Oceans.

Thomson, A. December 1996. *Whistler Region Fisheries Stewardship Plan*. Whistler, BC.

Tilden, F. 1977. *Interpreting Our Heritage.* 3rd edition. Chapel Hill, NC: The University of North Carolina Press.

Tobe, E. B. April 1999. *Squamish-Cheakamus Rivers Watershed Management Plan*. Draft proposal #2. Squamish, BC.

Tourism Whistler. January 2000. *Business Performance Statistics*. Whistler, BC: Department of Research, Tourism Whistler.

Town of Vail. 1994. *Environmental Strategic Plan*. Vail, CO.

UMA Environmental. 1998. *Watershed Action Guide: A Practical Guide for Building Partnerships, Projects and Processes for a Sustainable Watershed*. Mississauga, ON: Ontario Ministry of Natural Resources.

United States Department of the Interior. 1998. *Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas*. Technical Reference 1737-15. Denver, CO: Bureau of Land Management.

United States Environmental Protection Agency. Office of Oceans, Wetlands and Watersheds. 1997. *Top 10 Watershed Lessons Learned*. http://www.epa.gov/owow/lessons/intro.html.

Urry, J. 1990. *The Tourist Gaze*. London: Sage.

Wagar, J.A. 1973. Interpretation to increase benefits for recreationists. Paper presented to the Recreation Research Applications Workshop, June 1973, Marquette, Michigan.

Waldron, D. December 1999. *Whistler Environmental Strategy*. Discussion paper. Whistler, BC: Resort Municipality of Whistler.

Wark, R.J., R.A. Miller and D.E. Harper. 1999. Taking ownership of problems and solutions in watershed management: a collaborative framework from Craigflower watershed. In *Confronting Uncertainty: Managing Change in Water Resources and the Environment*, edited by P. Galvagno, proceedings from a conference hosted by the Canadian Water Resources Association, British Columbia Branch, 27-29 October, Richmond, BC: Canadian Water Resources Association.

Weiss, L.A. 1990. Effects of urbanisation on peak streamflows in four Connecticut communities, 1980-84. *USGS Water-Resources Investigations Report 89-4167*.

Whistler Resort Association. May 1999. Whistler Resort: Business Performance Statistics. Whistler, BC: Department of Research, Whistler Resort Association.

Williamson, D. June – December 1999. Personal communication with consultant, Cascade Environmental Resource Group. Whistler, BC.

Williamson, D. 1992. Which came first, the community or the resort? In *Mountain Resort Development: Proceedings of the Vail Conference*, edited by A.M. Gill and R. Hartmann. Burnaby, BC: Centre for Tourism Policy and Research, Simon Fraser University.

Yates, S. 1988. *Adopting a Stream: A Northwest Handbook*. Seattle, WA: The Adopt-A-Stream Foundation.

Yin, R. K. 1993. *Applications of Case Study Research*. Applied Social Research Methods Series, Vol. 34. London: SAGE Publications.

Zandbergen, P. 1998. *Urban Watershed Assessment: Linking Watershed Health Indicators to Management*. CD-ROM. Vancouver, BC: Institute for Resources and Environment, University of British Columbia.