WORKSHOP PROCEEDINGS

Urban Stream Protection, Restoration and Stewardship in the Pacific Northwest

Are we achieving desired results?

March 10-12, 1997

Douglas College
New Westminster, B.C.

Urban Initiative Series #08

Prepared for:

Fraser River Action Plan
Fisheries and Oceans Canada

Prepared by:

Quadra Planning Consultants Ltd.

Canadian Cataloguing in Publication Data
Main entry under title:
Workshop proceedings urban stream protection,
restoration and stewardship in the Pacific Northwest :
are we achieving desired results?

(Urban initiative series : #08)
Workshop and field trip, March 10-12, 1997, Douglas
College, New Westminster, B.C.
Includes bibliographical references.
ISBN 0-662-26020-1
Cat. no. Fs22-3/8-1997E

1. Stream conservation -- Northwest, Pacific.
2. City planning -- Environmental aspects --
Northwest, Pacific.
3. Stream ecology -- Northwest, Pacific.
I. Quadra Planning Consultants.
II. Fraser River Action Plan (Canada)
III. Series.

QI1541.5.R52S7 1997 333.91’6216’09795 C97-980327-6

Urban Stream Protection, Restoration and Stewardship in the Pacific Northwest
Are we achieving desired results?

Workshop and Field Trip
March 10-12, 1997

Douglas College
New Westminster, B.C.

TABLE OF CONTENTS

Urban Stream Protection, Restoration and Stewardship in the Pacific Northwest
Are we achieving desired results?

Workshop and Field Trip
March 10-12, 1997

Douglas College
New Westminster, BC

PREFACE

"Urban Streams". These words conjure up a myriad of images. In years past, yet not so long ago, urban streams, for many, would have meant - flooding, filling, draining, dyking, channelling and damming. They were impediments to our desire to build places suitable for living and working. In many communities it is even difficult to see evidence of where streams once existed. These "lost streams" were filled and culverted. Today, streams are being "lost" for other, more insidious reasons, such as pollution from urban, industrial and agricultural activities, removal of riparian areas, straightening of stream channels. The degradation and decline in the quality of our streams is not always readily apparent. However, it is well known that the capability of our streams to produce and support a diverse and abundant range of organisms has been severely constrained. Throughout the Pacific Northwest we see growing lists of threatened and endangered fish and wildlife species that depend upon streams for their existence. In most urban areas of the Pacific Northwest, the manner in which we have treated our streams is a reflection of how as a society we have planned and built our communities.

Just as parks, natural areas and open spaces are being viewed more and more as the "lungs" of urban areas, streams are the lifeblood or arteries of our urban environments. They are indicators of environmental health and quality of life. There is perhaps no other ecoregion of North America with greater biodiversity than the Pacific Northwest of North America. It also has a diversity of built and natural landscapes - heavily urbanized areas that are intertwined with waterways of all shapes and sizes - some originating in aquifers that straddle the international boundary, others in mountainous headwaters. While many streams have been lost over the past century, there is hope that the next century will see an improvement in the health of our urban streams. Efforts to protect and restore urban streams have been underway for some time, with varying degrees of success.

Our knowledge of how to protect and restore streams has grown immensely in the past two decades. The workshop brought together over 100 participants who work with urban streams in the Pacific Northwest, including biologists, engineers, hydrologists, planners, and stream stewards from British Columbia and Washington State. All share a commitment to ensuring that urban streams are protected and to finding ways of restoring and managing these lifelines of our urban landscapes.

The workshop provided a forum to share approaches, experiences, techniques and tools of the trade for protecting, restoring and stewarding urban streams within the Pacific Northwest on both sides of the international border and to take a critical look at whether or not desired results are being achieved.

The workshop was sponsored by Fraser River Action Plan (FRAP), Department of Fisheries and Oceans, B.C. Ministry of Environment, Lands and Parks and Douglas College's Institute of Urban Ecology. A workshop steering committee guided the organization of the workshop. The committee

members were: Otto Langer, FRAP; Melody Farrell, FRAP; Fern Hietkamp, FRAP; Geoff Chislett, MELP; and Eric Bonham, MELP. Bob Fuerstenburg and Gino Lucchetti, King County Surface Water Management, provided valuable advice on workshop topics and speakers. The workshop field trip was organized and led by Bruce Reid and Barry Chilibeck of the Department of Fisheries and Oceans. Val Schaefer, Director, Institute of Urban Ecology, Douglas College arranged for the use of rooms at Douglas College. The workshop was organized and proceedings prepared by Mike McPhee and Janine Robinson of Quadra Planning Consultants Ltd.

The three day workshop included two days of presentations and discussions followed by a one day field trip to examine urban streams projects in the Lower Mainland. The first two days were divided into four sessions: Impacts; Protection; Restoration and Stewardship. A dinner was held on the evening of Day 1 (March 10th) at the Inn at Westminster Quay, with Howard Paish as the dinner speaker.

The proceedings include abstracts or summaries provided by the speakers from each session, followed by a transcribed discussion period. The field trip itinerary is also included. In order to facilitate further use of these proceedings as a tool for those who work with urban streams issues, participants provided references for resources that they find useful in their work. These are organized in Appendix B. Biographies of the speakers are included in Appendix A. Appendix C is a list of all speakers and participants and their contact information.

For more information or additional copies, contact:

Habitat and Enhancement Branch

Department of Fisheries and Oceans

Suite 400 - 555 W. Hastings Street

Vancouver, B.C. V6B 5G3

WELCOMING REMARKS AND SETTING THE STAGE: What Do We Expect to Achieve From This Workshop?

Otto Langer, Fraser River Action Plan (FRAP), Fisheries and Oceans Canada

It is obvious that in the Lower Fraser Valley, the major urban area in British Columbia, our urban streams are under tremendous pressure and the fish populations in these streams have suffered accordingly. One can look at salmon escapement records in many Lower Fraser Valley streams and note that over the past 20-40 years, species such as pink, chum, and coho salmon populations have decreased or in some cases have disappeared from certain streams. Some will note that coho population decreases are due to over fishing and unfavorable ocean conditions. However, habitat in Lower Fraser Valley streams has been so degraded by urban and industrial development, one would be foolish to assume that if there were no other limits to coho production, that with a great deal of stream restoration, runs could be restored to the levels seen in the 1960s and early 1970s.

If our streams are indeed being harmed, what have we been doing about it? Prior to 1977, there was no legislation in Canada that protected fish habitat. Canada Fisheries Act legislation to protect water quality goes back to 1868 but nothing was in place to protect the physical habitat of fish for another 110 years.

With Fisheries Act habitat protection legislation in place, in 1978 the Department of Fisheries and Oceans (DFO) developed the first Land Development Guidelines to guide the public towards compliance with this legislation. Compliance was less than adequate.

As a result of national concern about the continued loss of fish habitat in Canada, DFO developed a National Habitat Policy in 1987. Key objectives of this policy were to conserve existing fish habitat, restore lost habitat and develop new habitat. The conservation goal was based on refusing alteration of valuable habitat and if habitat is lost, replacement habitat had to be built (i.e. compensation). Overall, a net gain of habitat was to occur.

In 1993, DFO and the Province of B.C. updated the Land Development Guidelines to offer developers better guidance to avoid harming fish habitat. It soon was apparent that the guidelines were slow to take hold and a new approach was required to assist in implementing guidelines.

Consequently, the Fraser River Action Plan (FRAP) took a lead to promote a program of stewardship in the Lower Fraser Valley. This program promoted awareness, communications and proactive planning, partnerships, new ways of doing business and regulatory reform. Some of these initiatives were not new to DFO. Over 15 years ago our Public Involvement Program had pioneered local community involvement and programs, such as storm drain marking.

The FRAP urban program focused on the development of community and local government levels. We worked with partners to produce the Stream Stewardship document for planners and developers, exposed municipal staff to the Land Development Guidelines, published a Greenways document, a Lost Streams poster and initiated studies to guide planners, politicians and developers out of our past ineffective way of protecting streams in the face of never-ending growth.

Finally, whether we are in King County or in the Greater Vancouver Regional District, we know we must face near impossible challenges to maintain viable salmonid streams in the urban environment. We are often split on whether we are making progress or failing in our task. Ignoring that issue, we can agree that many of our programs are being downsized and less resources are available to do the job than a few years ago. If we are to be effective in protecting streams as growth and sprawl spread through our watersheds, we will have to show very positive results in the next few years, or the future

of our next series of urban streams will continue to look bleak as development continues to spread across the landscape.

Are our stream protection, restoration, and stewardship initiatives working? A primary goal of this workshop is to learn from others and make that assessment.

Bob Fuerstenberg, King County Department of Natural Resources

In much of the Pacific Northwest, particularly in Washington state, urbanization has virtually replaced forestry and agriculture as the dominant threat to the quality and quantity of salmonid habitat. The generic city is moving rapidly outward toward the foothills, overtaking the streams, rivers and wetlands that are the environments of salmon. This is particularly true of the rather small creeks and streams that once dominated the Puget Lowland and the area where Seattle now sits. One estimate suggests that, within the city limits of the City of Seattle, about 90% of once-salmon bearing streams have been so greatly modified - by channelization, by culverts or by diversions into storm drains - that they no longer provide usable habitats for anadromous salmonids. In one particular stream, all first order tributaries -some 60 % of the total stream length - have been placed in culverts below ground. The building of roads to serve urban areas has resulted in many crossings with conditions that inhibit upstream migration. In a survey of King County done in 1989, impassable road crossings restricted access to approximately 50% of the county's total anadromous stream miles.

An often overlooked effect is the development of urban water supply that removes water from rivers by erecting diversion and storage dams. These features generally have no provisions for fish passage and often block considerable portions of the rivers. In the Green River system in King County, for example, a dam erected in 1963 blocks about 60% of the steelhead habitat in the river.

These direct effects on habitat have declined in recent years as ordinances and regulations that control such activity have been put into place. In King County, Washington, for example, the Sensitive Areas Ordinance passed in 1900 requires buffers from 25 to 100 feet on all streams as a condition of development. More recently, the Washington Growth Management Act requires counties to identify sensitive areas such as streams, and promulgate rules to protect them.

However, these direct effects on habitat have been replaced by more insidious and indirect effects that are a result of large-scale modification of the watershed. Urbanization brings about gross changes in hydrology and sedimentology, and produces important changes in water quality - especially temperature and pollutant loads. As landscapes are changed from forest and farm to the impervious surfaces of cityscapes, the processes that shape habitats for salmon are inescapably altered. Our next efforts must be directed at these effects, no matter how intractable they appear.

Eric Bonham, Urban Salmon Habitat Program, B.C. Ministry of Environment, Lands and Parks

"*We are in an unusual predicament as a global civilization. The maximum that is politically feasible, even the maximum that is politically imaginable right now, still falls short of the minimum that is scientifically and ecologically necessary.*" Al Gore, US Vice President

The point made here is that we need to continually cross institutional boundaries to draw the collective wisdom of the private/public sector as well as the citizen and academic enclaves to embrace an integrated approach to habitat management in the urban context. The fisheries issue in urban areas requires innovative solutions that address underlying issues such as growth management, water quality and land management matters.

The Urban Salmon Habitat Program (USHP) is based upon partnerships that include federal, provincial, and local governments as well as stewardship groups and educational institutes including schools and universities.

Growth in the Georgia Basin can be expected and the population in the next 10-20 years may be expected to double with the result that ecologically sensitive areas such as floodplains, riparian corridors and wetlands will be severely affected unless there is strong citizen awareness along with pro-active local governments prepared to embrace controls, regulation and education at the local land planning stages. It is these ecologically sensitive areas that are of course the very nurseries for the rearing and life-cycle of the salmonids.

We need to ask the right questions:

- What is the ecological footprint for the Georgia Basin?
- Can we have continual growth and at the same time retain the integrity of the natural systems in urban areas?
- Do we have the political will to make it happen, i.e. protect natural systems?
- When will we value the intrinsic worth of natural systems in the economic analysis?

SESSION 1: IMPACTS

Chair: Mike McPhee, Quadra Planning Consultants Ltd.

SOME IMPACTS OF URBANIZATION ON STREAM FISHES IN THE LAKE WASHINGTON WATERSHED
Kurt Fresh, Washington Department of Fish and Wildlife

FISH HABITAT SUSTAINABILITY IN THE LOWER FRASER VALLEY
Otto Langer, Fraser River Action Plan, Fisheries and Oceans Canada

THE IMPACTS OF URBANIZATION ON STREAMS IN KING COUNTY, WASHINGTON
Bob Fuerstenberg, King County Department of Natural Resources

IMPACTS OF LAND USE ON SALMON STREAM HYDROLOGY
Ken Rood, Northwest Hydraulics Ltd.

THE URBAN RIPARIAN ZONE AND IMPACT ASSESSMENT METHODOLOGY
Susan Wilkins, Pottinger Gaherty Environmental Consultants Ltd.

IS THE LOSS OF HABITAT INEVITABLE WITH URBANIZATION?
Tom Holz, SCA Engineers Inc., Lacey, WA

SOME IMPACTS OF URBANIZATION ON STREAM FISHES IN THE LAKE WASHINGTON WATERSHED

Kurt L. Fresh - Washington Department of Fish and Wildlife, Olympia, WA

ABSTRACT

Urbanization is the conversion of forested lands to impervious surfaces where the primary uses are commercial and residential in nature. Physical effects of urbanization include modification of hydrologic regimes, changes to riparian zone vegetation, loss of streams, reconfiguring of stream channels by construction of levees, and modification of water quality. The net result of these changes is simplification of aquatic habitat caused by the loss of large woody debris, loss of pool habitat, changes in substrate composition, and changes in channel shape and configuration. While physical effects of urbanization are well known, biological effects, especially those on stream fishes are not well understood. In this presentation I examine some effects of urbanization on stream fish in the Lake Washington Watershed of Washington State.

The Lake Washington Watershed encompasses some 2,800 sq km with elevations ranging from sea level to nearly 1600m and includes 4,423 km of streams in 13 primary drainage basins. Overall, 86% and 14% of the watershed was classified in 1992 as forested and developed, respectively, although this varies widely between basins.

The specific questions addressed in this study were:

1) Does urbanization change the composition of salmonid and non-salmonid species rearing in streams?, and

2) Has urbanization contributed to the decline in numbers of anadromous fish spawning in the watershed?

I differentiate in this analysis between lightly urbanized basins (<10% impervious surface) and ones that are heavily urbanized (>10% impervious surface). To evaluate the above questions I used data sets collected at large spatial scales (i.e. basin and watershed). Such an approach is useful because many of the ecological processes that determine the nature and abundance of stream fishes operate at large scales and thus impacts may be more readily detected with information collected at such scales.

To evaluate if urbanization impacts the composition of salmonid and non-salmonid fish assemblages using stream habitats, data obtained in surveys of fish occurring in basins throughout the watershed in the summers of 1983 and 1996 were utilized. Both surveys used electroshockers to measure relative abundance of fish in small sections of stream (20-60m) throughout basins. The 1983 survey was conducted by M. Muto and J. Shefler (1983). Game fish distributions were examined in selected streams within the Lake Washington drainage basin. (See Washington Department of Game, Fish Management Division, Report 83-9 for results of 1983 survey; the 1996 data is unpublished). Total number of species present in the 1983 survey was 8 (1 exotic, 7 native) with an average of 3.5 species per basin. In 1996, 11 species were found (3 exotic, 8 native) with an average of 5.3 species per basin. In both years, exotic species were rare, occurring at less than 5% of sites sampled. Numbers of species should be considered minimum estimates because sculpins were not always identified to species; four species of sculpin (torrent, riffle, coastrange, and prickly) occur in the watershed. One striking difference in species composition between the two years was the complete absence of dace (both speckled and longnose) and lamprey in 1983 and their occurrence in a number of basins in 1996.

The numbers of species occurring in lightly urbanized versus heavily urbanized basins did not differ substantially. For example, in 1996, there was an average of 5.5 species in lightly urbanized and 5.3 in heavily urbanized systems. In addition, no clear trends in occurrence of exotic species were discernible, primarily because so few exotic species were caught. There were, however, some major differences in sculpin populations between lightly urbanized and heavily urbanized basins. In 1983, sculpins were present in 39% of sites in lightly urbanized systems and in 10% of sites in heavily urbanized basins. In the 1996 study, the same pattern was found with 91% of sites in lightly urbanized basins having sculpins present and only 40% of sites in heavily urbanized basins having sculpins present. One hypothesis that could explain these results is that because sculpins are directly associated with bottom or benthic habitats, larger and more frequent flood events and a lack of suitable, refuge habitat in heavily urbanized streams "flush" sculpins from the system.

Urbanization also appears to alter the composition of stream-dwelling salmonids. The two dominant salmonid species in the Lake Washington Watershed are coho salmon and cutthroat trout. In both years, cutthroat and coho were more widely distributed in lightly urbanized basins, reflecting the better overall quality of habitat present in these basins. However, the 1983 and 1986 data show that the numerically dominant species shifts from coho salmon to cutthroat trout as the extent of urbanization increases. The 1996 data parallels the relationships developed between habitat impacts and change in impervious area. Above 10% impervious area, habitat damage is severe and probably not repairable. Similarly, when the amount of impervious surface exceeds 10%, there was little change in the relative abundance of coho and cutthroat trout. Juvenile coho salmon require pool habitats to successfully rear in streams and as levels of development increase, pools are eliminated and coho abundance declines. Why cutthroat are more tolerant of urban environments is presently unknown.

The final question addressed here concerns the role that urbanization has played in declines of anadromous species in the watershed. Escapements of the four anadromous species that use the watershed - sockeye, coho, chinook, and steelhead - have all declined in recent years with the lowest returns of each species occurring since 1990. The specific role that impacts to freshwater spawning and rearing habitats have played in the decline of these populations is difficult to analyze because reasons for salmon population fluctuations are multiple, complex and often interrelated. As a result, separating effects of these various factors is problematic. However, because freshwater habitats are such a critical part of the life support system for salmon, it is reasonable to hypothesize that urbanization has contributed to declines of anadromous species in the watershed. The results of salmon spawner surveys conducted by the Washington Department of Fish and Wildlife suggests this is the case. The percentage decline in spawner population indices as a function of amount of impervious surface (based upon 992 Landsat photographs) in selected basins is greater in more heavily urbanized basins. This relationship was curvilinear and asymptotes at an impervious area of 10-15%, which is the same level where physical changes to aquatic habitat become most significant and likely irreversible. Habitat change resulting from urbanization is a likely explanation for these results because other factors (e.g. harvest, changes in ocean conditions) should affect populations in all basins equally.

In summary, the net effect of physical changes resulting from urbanization is to simplify aquatic habitat. One effect of these changes can be a reduction in the abundance of spawning adult salmon. In addition, as basins become more heavily urbanized, sculpin populations are reduced and eventually eliminated, juvenile coho abundance declines, and cutthroat trout abundance increases.

Discussion

Q: With your data related to anadromous salmonids, did you correct for the cyclic dominance/sub-dominance every four years?
A: In the Lake Washington watershed, it is not clear that a pattern of dominance/sub-dominance exists.

Q: What percentage of the decrease in sculpin populations can you attribute to culverts (because sculpins are notoriously poor leapers)?
A: Estimated impervious surface is only an integrator - it does not provide any conclusions about whether loss in sculpins is due to culvert blockages, loss of large rocks, woody debris, or straightening of streams. But the point is that the effects of urbanization result in loss in sculpin.

SUSTAINABILITY OF FISH HABITAT IN THE LOWER FRASER VALLEY

Otto Langer - Fraser River Action Plan, Fisheries and Oceans Canada, Vancouver, B.C.

ABSTRACT

The Fraser River Basin covers an area of 200,000 km^2. This basin drains about 1/4 of the land mass of British Columbia. The Lower Fraser Valley covers about 6% of the basin and about 1.5% of the area of the entire province. Of this latter 1.5%, about 40% of that area is settled by farms and urban environments. This settlement area therefore accounts for 0.6% of the province's land mass. Of B.C.'s 4 million people, about 65% live in this small area. During 1991-1996, 84% of all immigration to B.C. settled in this area.

Ecologically, the Lower Fraser Valley (LFV) is one of the most sensitive and productive ecosystems on the west coast of North America. The Fraser River and its most significant 200 tributary streams make up a system that is the most productive salmon stream in the world. The Fraser river mainstem, its estuary and about one half of its significant tributaries originate in or flow through the Lower Fraser Valley. Of the millions of spawning salmon that return to the Fraser each year, a large portion of the coho, chinook, and chum and pink salmon production occurs in the streams of the Lower Fraser Valley.

The rapidly evolving human development pattern and our past natural legacy has caused great conflict and loss to our salmon streams and associated habitats in the LFV. The major growth in this area and present land use practices set the scenario for greater pressures on this resource into the foreseeable future. Past settlement and land development practices have resulted in the loss and degradation of the salmonid and general aquatic habitat base.

Despite legislative changes and recent initiatives stressing improved protection, restoration and stewardship, the losses of the past have not been significantly reversed and pressures on remaining habitats continue to increase. Most often gains in the habitat base are offset by the high rate of growth and continued development of new lands for industry and homes.

In 1996 we initiated a review of the status of the 551 “atlased” streams in the settled area of the Lower Fraser Valley (LFV).[1] This area is bordered on the west by the Pacific Ocean and extends east 150 km to the town of Hope. On its northern limit it is defined by the north shore mountains and extends south to the Canada/USA border. This review was based on a review of the literature, archival and TRIM and 1995 digital ortho aerial photos, and the knowledge gleaned from numerous agency and public stream practitioners that spawned hundreds of years of experience in this area.

Streams were classified as lost, endangered, threatened or wild based on a set of impact criteria developed to evaluate the environmental status of each stream in the study area. The impact criteria were:

- channelization, armourization, or dyking of 50% of the fish frequented length of the stream;
- effective impermeable area (EIA) covering over 15% of the stream’s watershed;
- greater than 50% diversion of stream flow (i.e. diversion out of the system);

[1] *Wild, Threatened, Endangered and Lost Streams of the Lower Fraser Valley, Summary Report*. 1997. Fraser River Action Plan, Fisheries and Oceans Canada.

- significant loss of riparian vegetation along more than 50% of the fish frequented length of the stream;
- permanent deforestation of over 50% of the stream basin;
- documentation of severe water quality problems.

A stream was considered lost if 3/4 or more of its length was covered (e.g. in an underground sewer). If two or more of the above criteria applied, it was considered endangered. If one of the criteria applied, it was threatened and remaining streams, although often not in a pristine state, were considered wild. For evaluation purposes, the LFV was divided into 4 areas:

Area 1 Steveston to Langley

Area 2 Abbotsford to Hope

Area 3 Stave River to Hope

Area 4 West Vancouver to Stave River

The results of this study indicated that most streams are under greater stress than previously feared. Generally streams in the flatland and gentle terrain areas are most significantly altered and endangered. Many miles of waterways, called streams, amount to little more than drainage ditches. This is due to the early development of those lands for agriculture which were then often converted to industrial and residential uses.

Areas with the most wild streams were areas removed from settlement areas and often characterized by steep terrain. Unfortunately many of these streams had few fish in them or often were of such torrential nature that they were non-fish bearing. Many of our most productive salmon streams that have an opportunity to survive in the urban environment are presently in the threatened category. Strong leadership in altering our land use practices must be immediately put into place or they will become endangered and become non-viable producers of salmon. Many endangered streams require enhanced protection and significant restoration or they may as well be considered as streams with minimal or no ecological value.

In such a strategic habitat review, one cannot ignore the status of the Fraser River estuary. Although it has also undergone great development by drainage, dyking, filling and dredging over the past 120 years, it is of global significance. A recent study by DFO has shown that of 2000 ha of estuarine North Arm marsh available to fish in 1860, a scant 100 ha now remains. Wetlands in other parts of the estuary have not fared much better. We are now managing a residual estuarine complex and, as with urban streams, it is under significant pressure. A study completed by FRAP in 1996 reviewed the status of 60 projects between 1983 and 1993 to determine our success in achieving a no net loss of habitat capacity in remaining estuarine habitats[2]. The review indicated that we are holding our own in estuarine marshes but have lost significant subtidal habitat, mudflats and riparian areas during that period. This is despite a focused multi-agency effort to sustain the natural environment in this part of the LFV.

In conclusion, based on the criteria of our strategic stream overview, the status of Lower Fraser River fish streams and estuarine habitat are almost all in a threatened or endangered category. Some of the most significant losses occurred prior to the large migrations of human population to this area (i.e. before 1950). However, the pressures on remaining habitats continue to be great as about 85% of new growth in B.C. takes place in the LFV.

[2] *Habitat Compensation, Restoration and Creation in the Fraser River Estuary: Are We Achieving a No Net Loss of Fish Habitat*? Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2349. 1996. Fraser River Action Plan, Fisheries and Oceans Canada.

Despite significant efforts, we have yet to achieve a no net loss of the productive capacity of our overall stream habitat base during the past decade. As new development occurs, many streams in the fringe area of development bear the brunt of new urban sprawl. The leadership and will to develop new approaches and apply present legal and technical protection tools will slow down but not reverse the trend of losses. Restoration projects cannot be expected to replace stream protection. An overall change in land use strategies must take place or the long term viability of salmon habitat and salmon populations will continue to decline as development occurs.

Discussion

Q: Regarding the study where some lots had covenants and others did not, did the lots without covenants back onto parks/deep ravines?
A: The study was done on all fish-bearing water in Surrey. There were no deep ravines and all lots were private properties. In most cases the property-owner owned the stream.

Q: Is DFO involved in any regional growth management strategies?
A: In theory, yes; there is a Growth Management section in the Municipal Act, and the GVRD has a growth management strategy in which DFO was involved. However, I do not think this will have any great effect in addressing any of the environmental issues we are concerned about. Development and money drive the land development process, and we do not yet have the land ethic that puts value in natural resources. DFO is trying to plug into growth management strategies and Official Community Plans. It is key for senior government to participate and over the next few years, hopefully we will see all three levels of government working together.

Comment: Paul Ramsay had said that because of the high rate of growth in the Lower Mainland, there is a possibility for incentives to try to deflect people to outlying areas. However, this just shifts the problem elsewhere.
A: Yes, but in outlying areas, the population is more spread out, the density of streams is not as great, so such areas could absorb more people (and probably do less damage). In the Lower Mainland, you can do more damage - there is much more rainfall, many more streams, and many more species of fish crammed into streams - as we move into the interior streams are more spread out. Immigration issues have an effect - and DFO has no control over that process.

Q: What were the criteria for determining whether municipalities "bought in" to environmental stewardship?
A: We had a set of ten criteria, such as whether or not they have tree removal bylaws, etc. What is needed is a "green" elected council and an environmental co-ordinator on staff. For example, Richmond has an influx of new people and thus the influence of the environmental values from other parts of the world.

THE IMPACTS OF URBANIZATION ON STREAMS IN KING COUNTY, WASHINGTON

Robert R. Fuerstenberg - King County Department of Natural Resources, Seattle, WA

ABSTRACT

The characteristics of urban streams in King County, Washington are typical of many streams in other developed areas of the Pacific Northwest. In King County, urban streams are often badly eroded; many are wider and deeper than their counterparts in undeveloped watersheds; they are often devoid of large woody debris and lack significant pools - long reaches of uninterrupted riffle are common; interstitial spaces among the bed gravels are generally packed with silts and sand, often to great depths; and the flow regime - the pattern of seasonal (and longer) high and low flows - is profoundly altered. Water temperatures tend to be higher and pollution episodes - especially turbidity - are more frequent and longer lasting. In response to these effects, the biota of urban streams is often quite depauperate. Macroinvertebrates, such as molluscs and aquatic insects, are often the first to respond - their diversity tends to be lower in urban than in non-urban systems. The less tolerant among them - the freshwater mussels, the stoneflies, mayflies and many species of caddisflies - are replaced by groups with greater sufferance for the changed conditions. Among the fishes, the anadromous species such as coho and steelhead tend to be lost first, followed by resident trouts and some species of sculpins. In extreme situations, some streams have become virtually lifeless.

In the lowland areas of King County, indeed, throughout much of the Pacific Northwest, urbanization has become the dominant threat to the structure and function of stream environments and to the survival of their inhabitants. As landscapes are developed for industrial, commercial and residential uses, as forests and fields are replaced with roads parking lots and roofs, the delicate relationships among hydrology, geology and biology that sustain our stream ecosystems are changed dramatically. As urbanization proceeds and the landscape becomes increasingly developed, stream ecosystems have been altered in ways that have reduced the diversity of habitat types within streams and among them - single streams have become structurally simpler and streams throughout the region have come to resemble each other in this lack of diversity. Stream systems once dominated by pools and riffles with diverse depths and velocities have become smoothed and homogeneous, eliminating the variety of spawning, rearing and resting habitats.

Historically, this alteration has occurred directly by activities such as channelization, dredging, filling and streamside clearing. In Thornton Creek, for example, a small stream in northern King County, all first-order tributaries have been lost to culverts and diversions, reducing the stream length by some 2 miles - slightly more than 30 per cent of the historic length. Moreover, of the remaining stream, fully 90 per cent has been channelized, its banks armored by rockeries and revetments to protect streamside residents. Many of these same residents visit upon the stream a variety of other indignities that reduce the stream diversity, as well. In King County at least, this direct loss and modification has been reduced significantly by stream protection ordinances and rules governing development near such sensitive areas.

More insidious however, is the indirect alteration of stream systems by land use and management activities that alter the processes responsible for the form and function of stream ecosystems. Two examples are instructive. As a watershed undergoes development and the landscape is changed from forest or farm to city, the rates and magnitudes of surface erosion and stream discharges increase considerably. Erosion rates from urbanizing basins may exceed by 10 to 100 times the rates of

forested watersheds. Even after a basin has been more or less completely developed, the sediment delivery rate may still be 3-5 times the forested rate; increases in turbidity are a common feature of urban streams, even during small runoff events. This chronic delivery of sediment results in bed-packing and cementing of gravels. Perhaps more pernicious, the hydrology of an urbanized watershed (defined as a watershed with 50 percent of its land area in urban uses) is changed considerably when compared to a similar, undeveloped one. Most notable is the dramatic increase in the peak flow from the urbanized watershed. Development typically reduces the vegetative cover in a watershed and increases the ratio of impervious to non-impervious surface. This change reduces both interception and infiltration, at once increasing the surface water volume and speeding the movement of water off the landscape and into stream channels. As a result, flows rise rapidly; peak flow increases of 150 to 250 per cent (compared to flows in undeveloped watersheds) are common in urbanizing watersheds of King County.

But urbanization does considerably more than simply magnify peak discharges. The frequency of peak flows increases as well, and entirely new runoff events occur. For example, if the discharge of the 5-year flood doubles following urbanization, then the pre-urban discharge must now occur more frequently than every 5 years, on average. These changes can be quite dramatic. In a small watershed of south King County, an examination of thirty-nine years of streamflow data (using a flow simulation model) revealed 8 discharges at or above the 5-year discharge for the basin in a forested condition. The intervals between such floods are quite variable; events are separated by as many as 14 years, others coming in successive years. In contrast, in the urbanized condition, this event, rather than occuring (on average) about once in 5 years, now occurs about 5 times each year with a median interval between events of about 1 month. This same pattern is revealed in other urban basins in King County as well.

In general, urbanization alters the historic patterns of disturbance and recovery in stream ecosystems. The physical complexity - depth, velocity, substrate composition, along with other components of habitat - is grossly simplified; biological processes follow the same pattern. These findings suggest that successful protective and corrective measures must address not only the individual stream or reach but must extend to the watershed as well. Even so, the changes to the landscape wrought by urbanization are so pervasive that it is probably beyond our best efforts to fully correct them. It seems prudent, therefore, to develop our remaining landscapes with great caution, recognizing that the unique features of our stream ecosystems are both fragile and quite possibly irretrievable.

Discussion

Q: We talked a lot about the effects of flood flows. What about the flip side - if you dump it out all quickly, don't you get a loss in groundwater, and doesn't it have implications, especially in the summer?

A: Without groundwater recharge, the base flow decreases in late summer, therefore water quality decreases as well. We see this in some systems. In many cases, however, people actually import water, through watering their gardens, etc. So sometimes the baseflow goes up in the summer. To a salmonid, it may be strange to see more water at colder temperatures, when they are trying to grow in the middle of August. We do not know what the subtle effects of that are. But we have seen that pattern - a decrease in recharge equals an increase in baseflow.

Q: How has the engineering profession accepted your view?

A: There was a real clash in the beginning. We are coming closer together now. We are realizing that systems are very complex. In our wish to manage, we try to simplify and homogenize - but we cannot do this if we want to look at these systems ecologically. Engineers are starting to ask those questions - they are asking me for papers about ecology. We are familiarizing and educating each other. There are ways to use engineering techniques much more subtlely. Our Stormwater Design Manual smooths the hydrologic system (homogenizes the flows), but salmon are adapted to variable systems. We need to use a different way of using engineering techniques to build uncertainty back into the ecosystem.

Q: You mentioned "sensitive areas rules" in your presentation? Do they exist?
A: Yes, but they focus on the stream and the immediate riparian zone - they do not link the landscape with the streams. Buffers are only about 2% of the landscape, and they can only do so much. The rules are necessary, but they are insufficient to protect streams

Q: Have you tried to push the effective impervious area numbers, for example, to keep development only to 10%?
A: Yes. We are starting to work on that. The Centre for Watershed Protection in Maryland is doing work in that area; maybe we will have more information on that next year.

IMPACTS OF LAND USE ON SALMON STREAM HYDROLOGY

Ken Rood - Northwest Hydraulics Ltd., North Vancouver, B.C.

ABSTRACT

As part of the sustainable development planning by the Fraser River Action Plan, we examined the hydrology regime, and the effects of development on that regime, for salmon streams in the Fraser Delta, Pitt-Stave and Chilliwack-Lower Fraser Habitat Management Areas.

The hydrologic regimes of the salmon streams within the Lower Fraser Valley vary as a result of climate, surficial geology and land use. Annual precipitation (and mean annual flow) increases to the north, towards the Coast Mountains, and to the east, up the Fraser Valley, varying roughly from about 1,000 to 2,000 mm. Annual hydrographs closely follows the precipitation cycle - the greatest flows are in November, December and January, when a succession of Pacific storms cross the coast, and minimum flows occur after several dry weeks in July, August and September. The watersheds of the salmon streams are often small to moderate-sized and their 7 day summer low flows range from ten to a few hundred litres/second.

The surficial geology of the lower Fraser Valley is primarily a legacy of glaciation, except for the recent alluvial deposits on the Fraser River floodplain. Armstrong (1981; 1984) describes the deposits in detail. However, for hydrology, they may be grouped into "till-like" deposits, including relatively impermeable glacio-marine and moraine, and glacio-fluvial deposits, the permeable gravels and sands laid down by flowing water. The glacio-fluvial deposits are unconfined aquifers, and watersheds with a significant portion of these deposits typically have higher summer base flows, due to groundwater discharge, and smaller flood peaks, due to groundwater storage.

The watersheds of many of the salmon streams are partly urbanized, but still actively farmed. Clearing for agriculture increases natural peak flows and surface water removal for irrigation reduces instream flows during the summer. Irrigation extractions are the most significant use and are important to the salmon resource because they occur during minimum stream flows. Industrial licences and waterworks also reduce flows in some of the salmon streams. Domestic water use is insignificant.

The potential surface water demand for all uses was calculated from water licences, and compared to estimated natural summer flows. The following table summarizes the number of salmon streams with various percentages of their summer 7 day low flows potentially utilized for agriculture, industry or waterworks.

Table 1: Number of Salmon Streams with varying portion of their 7 day Low Flows Utilized for Surface Water Extractions.

% 7 Day Low Flow Utilized	FRASER DELTA HMA	PITT-STAVE HMA	CHILLIWACK - LWR FRASER
0	13	5	13
1 TO 10	5	4	5
10 TO 30	4	4	5
30 TO 50	1	2	4
> 50%	9	2	15
No. of Streams	32	17	42

Twenty-six of the 91 salmon streams that lie entirely within the Lower Fraser Valley potentially have more than 50% of their summer seven-day low flow utilized for surface water extractions. Groundwater extractions from shallow wells may further reduce minimum discharges in some watersheds; however, these are not recorded or regulated so it is difficult to estimate their impact on surface flows.

Little research is available on the effect of urbanization on low flows. However, it is expected that the effect is partly controlled by the surficial geology of the watershed. In impermeable or "till-like" soils, retention or detention structures may increase low flows by storing storm flow and gradually releasing it. In permeable soils, sufficient percolation to groundwater, combined with reduced evapotranspiration demand, may maintain the natural base regime.

Both agriculture clearing (and ditching and draining) and urbanization can increase peak flows. However, the role of clearing in increasing flood peaks is not well studied. A study, completed as part of the Fraser River Action Plan, modelled the hydrologic regime of the Salmon River (near Fort Langley) in detail. Precipitation from nearby climate stations, soils, land use, groundwater inflows, and water extractions were used to develop an HSP-F hydrologic model for the watershed that predicted hourly discharge at a number of sites along the Salmon River. It was calibrated by comparing its output to hourly flows measured at the Salmon River at 72nd Avenue, Langley Water Survey of Canada gauge.

Once calibrated, the model was used to examine the effect of current land use on flood flows (principally the flood frequency curve). It indicated that existing development, primarily agriculture with about 2% of the watershed as effective impervious area, had doubled mean annual floods, compared to those predicted for a forested watershed.

Urban development often increases mean and peak flows by creating impervious area and concentrating storm runoff into streams. Its effect is best estimated from the effective impervious area (EIA) for the watershed of each salmon stream, calculated from the area of various land use types, as measured from zoning maps and confirmed on air photographs, expressed as a percentage of watershed area. These are summarized in the following table.

Table 2: Number of Salmon Streams with Varying Effective Impervious Area as a Percentage of their Watershed Area.

% Effective Impervious Area	FRASER DELTA HMA	PITT-STAVE HMA	CHILLIWACK - LWR FRASER
< 1%	2	10	28
1 TO 10%	18	4	13
10 TO 20%	3	1	0
20 TO 50%	9	3	1
> 50%	0	0	0
No. of Streams	32	17	42

Increases in peak flows (and changes in stream channels) are thought to begin at an EIA of about 5%. Peak flows increase directly with increasing %EIA, though retention or detention structures may help to slow the rate of increase. About 17 of the salmon streams are expected to have greatly increased peak flows as a result of urbanization; many of these drain the southern slopes of Burnaby and New Westminster. A further 35 of the salmon streams have %EIA where increases may be underway in their peak flow regime, or they may begin with only a little further development. The above comments refer to the main stream, at the mouth of the watersheds, and much greater changes may occur in small tributaries where urban development is concentrated.

The following conclusions may be drawn concerning land use and the hydrologic regime of the salmon streams:

Low Flows: Licenced water extractions for irrigation, industry, and waterworks reduce summer low flows in the salmon streams. About 36% of the salmon streams have more than 30% of their summer 7 day low flow potentially devoted to water demand; about 29% have more than 50% potentially subject to utilization. Many of the streams with no surface water demands are those with urbanized watersheds. It is not entirely clear how urbanization affects low flows: with impermeable soils, they may be increased; with permeable soils, they may not be altered. Further research is needed on this topic.

Groundwater extractions from unconfined aquifers are also thought to greatly reduce summer base flows in some watersheds, particularly those around the Abbotsford Aquifer. However, these are neither licenced nor regulated and little is known of their impact on base flows.

Peak Flows: Agricultural land clearing, accompanied by ditching and land drainage, increased peak flows in the salmon streams starting in the late nineteenth century. The magnitude of the increase is not known for many watersheds, but based on hydrologic modelling in the Salmon River watershed, mean annual flows may have been increased by 25 to 100%. Stream channels may not yet have completed their adjustments to this changed regime.

Urbanization also increases peak flows, and to a greater extent than agricultural clearing. About 19% of the salmon streams are expected to have greatly increased peak flows as a result of urbanization, mostly along the southern slopes of Burnaby and New Westminster and in Surrey. A further 38% of the salmon streams have %EIA where increases may be now be underway in their peak flow regime, or they may begin with a little additional urban development. Retention or detention structures are key to maintaining hydrologic regimes and channel stability in these watersheds.

The above analysis refers to the main salmon streams, at their mouths. Hydrologic regimes of their small tributaries may be greatly changed by individual urban developments although these may not yet have an appreciable effect on the hydrologic regime at the mouth. Stream channel erosion in these small tributaries may contribute coarse sediment to the main stream which may result in instability in the main stream.

Discussion

Q: With 2% impervious area, is there a doubling of mean annual runoff?
A: The impacts from natural state include impacts of urbanization, agricultural practices (ditching, etc.). The impacts of urbanization are not prevalent yet in this watershed. But we have had some impact on the flow regime.

Q: What if you moved the water survey gauge higher up in the watershed? Would you perhaps get a different picture?
A: There is a 50 square km watershed above this point. Some of the smaller watersheds may be significantly urbanized, and could have an effect. We have not carried on that far in the study. We are essentially at the calibration stage.

Q: Are you looking at geology as a major or minor factor?
A: Our modelling looks at response to impervious areas on various soil types. We treat hydrology differently for each soil type.

Q: Given that the watershed has gone through significant change in its hydrograph, how long will it take for the stream channel to stabilize?50 years? 25 years? Is it stabilized now?
A: I wonder - it may be close to stabilized now. It was harvested in the 1890s, so it has had some time. Doubling of the mean annual flood would make the channel about 50% wider. Some parts are stabilized by glacial deposits, other sections are alluvial, where the stream has been freer to adjust its width. It depends - it would be different in different areas.

THE URBAN RIPARIAN ZONE AND IMPACT ASSESSMENT METHODOLOGY

Susan Wilkins - Pottinger Gaherty Environmental Consultants Ltd., Vancouver, B.C.

ABSTRACT

Introduction

Assessing the impacts of urban development on riparian and aquatic habitat is coming under increased scrutiny as our cities expand and densify. The goal of protecting habitat and preserving urban streams is universally held, but the precise means of how to do this is the challenge.

The objective of this paper is to review and summarize the impacts of urban development on the riparian zone. The second objective is to review impact assessment (IA) methodology and examine how it has been applied to the assessment of impacts of urban development. Our hypothesis is that urban development usually proceeds piecemeal, so that the "Big Project" methods of impact assessment are never invoked or applied.

Impact Assessment of Urban Riparian Zone

The recognition that urban development was resulting in impacts on the aquatic and riparian environment prompted regulatory agencies to develop guidelines for urban development (Land Development Guidelines, 1993). Subsequent work by the Fraser River Action Plan broadened the scope of the assessment to understand the municipal role, and to take a more holistic view of stream as greenways (Community Greenways, 1996). Audits of the effectiveness of leave strips provide some useful feedback on both the methodology of assessment and the effectiveness of leave strips as a mitigation measure (Sigma Engineering, 1994). A more conventional approach to impact assessment of urban development has been recently attempted (Pottinger Gaherty Environmental Consultants Ltd, 1996). This has included scoping of key issues, an inventory of riparian vegetation using a plant ecologist, a multidisciplinary assessment and impact management plan, consideration of basin-wide cumulative impacts and community interests.

One of the challenges with urban stream impact assessment is the establishment of a baseline for comparison. Typically, a baseline inventory is conducted and potential impacts of the proposed project are compared against that baseline. However, in most urban areas, the old growth forest has long since been logged, and where trees have regenerated, a non-managed mix of second and third growth vegetation exists. Most urban watersheds have variable amounts of encroachment on the stream corridor and the hydrologic characteristics of the stream have been significantly altered through flow diversion, culverting and channelization. Water quality is usually compromised and impacts from spills and other human effects occur regularly. The biggest single difference between urban and pristine watersheds is that humans are an unavoidable part of the ecosystem.

Impact Assessment Methodology

The basic principles of impact assessment should be applicable to projects of any size. Based on the principles outlined in standard references such as Beanlands and Duinker (1983), the elements of an impact assessment are scoping, inventory, assessment, and impact management. The objective is to identify likely, significant, adverse effects of development using precisely defined measures of significance (CEAA, 1994). Typically, these include geographic extent, temporal extent, degree of reversibility, ecological/social context and magnitude. Social context is an increasingly important component as humans should be treated as part of the ecosystem and community involvement in a

essential element of decision making. Two other key concepts which are fundamental to impact assessment, are that a true impact assessment has to be multidisciplinary and that cumulative effects have to be taken into consideration.

Following conventional IA methodology, any significant adverse environmental effects have to be managed. Impact management is intended to eliminate, reduce or offset impacts through the three techniques of avoidance, mitigation and compensation. These are to be applied sequentially, which is also the hierarchy of preference indicated in the DFO No Net Loss policy. An integral component of an impact management plan is a monitoring plan, which consists of measuring ongoing environmental effects and the effectiveness of mitigation or compensation measures. Problems that arise when trying to apply impact management methods to urban development are: site specific versus watershed based solutions, how to deal with cumulative effects, and how to design meaningful monitoring.

Conclusions

The principal impacts of urban development on the urban riparian zone are:

- fragmentation of the riparian corridor
- removal of old growth forest
- altered hydrologic regime through flow diversion, culverting, channelization
- compromised water quality
- pressure for multiple use of greenways

With respect to methodology, we are not advocating a full EIA of every urban development application, but suggesting that the principles of IA may bring more logic and rigour to the methodologies used. Some of the problems that lead us to this conclusion are:

- despite the guidelines, urban habitat continues to dwindle and deteriorate;
- integrated watershed management and habitat stewardship are universally accepted goals but difficult to implement within the present framework;
- arbitrary guidelines may prejudge both the problem (impacts) and the solution (impact management plan);
- regulatory responsibility is diffuse and there is no clear mandate to consider a multidisciplinary impact assessment;
- with the present system, we may not taking advantage of all the tools in the tool box (i.e. - Schueler, 1996).

Discussion

Q: Re: petitioning developers for funding for stewardship projects. Stewardship groups often do not want to take money from developers. How would you deal with that?
A: Some direction is needed from agencies to figure out how they would like to see it happen. Perhaps agencies could “disinfect” the money. The developers have the money, and the stewardship groups have the desire and the goals - the agencies’ role could be to bridge the two.

IS THE LOSS OF HABITAT INEVITABLE WITH URBANIZATION?

Thomas W. Holz - SCA Engineers Inc., Lacey, WA

ABSTRACT

URBANIZATION AND HABITAT: WHERE ARE WE NOW

Streams running through a mature, pristine forest provide habitat for fish. In urbanized portions of the northwest we have, in a few generations, gone from pristine forests to pervasive urban sprawl. Concurrently we have gone from an abundance of habitat and fish to the point where urban streams are barren and some species are in danger of extinction.

A mature forest will evapo-transpire on the order of 40% of annual rainfall (Chow, 1964, pp.6-21,22). In the lowland streams in the northwest most of the rest of annual precipitation infiltrates and becomes groundwater. It can take months or years for groundwater to reach streams. In a natural state, only a small fraction of precipitation reaches the stream in less than a day. Under forested conditions peak flows are low and of short duration and refuge habitat is plentiful, streams are cool and clean, shaded by a biologically complex riparian zone, spawning gravel is open and un-silted, and groundwater feeds streams all summer. Under these conditions fish thrive.

Urbanization changes all that. The primary link between urbanization and the demise of habitat is excessive runoff. With mathematical models we have shown that in a built-out condition in the watershed, peak events in a stream can increase five to ten times the peaks seen in a pristine state. Groundwater flows in summer months that used to keep streams viable can go to zero. These radical fluxes in flow - huge flows in the rainy season to nothing in the dry months - devastate streams. If development continues along this pattern, hydrology, not water quality or riparian habitat, determines stream viability for fish. If the channel is incised 12 feet, the stream width doubles or triples, and spawning gravel is replaced with hard till bottom or fine silt. If pools disappear and the stream becomes one long riffle, it hardly matters what the riparian zone and water quality are like.

IT'S THE HYDROLOGY

Many have shown the relationship of increasing effective impervious surface and the dramatic increase in runoff in streams. Through modeling of flow of Woodard Creek in Thurston County, Washington (where it crosses Interstate 5) it has been shown that peak flows increased 10 fold from the pristine condition to the present highly urbanized (Thurston County, 1995). Increases of stream flow for a given return frequency of five fold are common. Beyerlein has shown that with urbanization you can expect that what was the 100 year flood in the pristine condition will occur every year or two in the urbanized condition (Beyerlein, 1996). He also shows however that it is not total impervious area that determines runoff, it is "effective impervious area", the impervious area actually connected to the receiving water by conveyance systems, a point returned to below.

Urban sprawl effectively increases impervious area roughly as shown in Table 1.

Table 1

Total and Effective Impervious Areas for Various Land Uses

Land Use	Total Impervious Area %	Effective Impervious Area %
Forest	0	0
Single Family Residential	40	26.4
Multi-Family	48	43.2
Commercial	68	81.7

Source: Beyerlein, 1996

With dramatic increases in flow with urbanization, the work done on stream channels is enormous. Bates (1983) and others have shown that stream morphology is determined by approximately the two year flood event, which he characterized as the dominant discharge. It follows that if what used to be the 100-year event is now the dominant discharge the channel will change shape. The destructive power of these flows can incise channels 12 feet in one storm taking with them spawning gravels and refuge habitat such as large woody debris (Booth, 1992). Johnson has shown that refuge habitat can be reduced to the point where smaller fish cannot stay in the stream. Stream banks are washed away making the channel wider and flatter. The pool/riffle pattern optimum for fish is transformed and most of the pools disappear.

It has been common practice in the past to include the stream corridor in the bounds of private lots. Landowners often will often clear the vegetation from banks right to the stream's edge and replace it with lawn. Often they will go into the channel and remove large woody debris to "tidy things up". These actions deprive the stream of cooling shade, and the fish of food sources (Lucchetti, 1992).

DEVELOPMENT THRESHOLDS AFTER WHICH STREAM DECLINE IS NOTED

Horner has reported that the impacts of urbanization on fisheries becomes detectable when the Effective Impervious Area in a basin predominated by Type C soils is about 10% (Horner, 1996). Lucchetti and Fuerstenburg place the threshold at 6%. (Horner also notes that total loss of stream functionality is observed at about 45% EIA.)

The author hastens to add that these thresholds are applicable on the poor soils that predominate in King County Washington. In Thurston County by contrast, urbanization in the upper reaches of Woodland Creek on outwash soils which predominate in the headwaters has had little effect on peak flows at the station at the mouth of Long Lake. The series of lakes that make up the headwaters of Woodland Creek also have a damping effect on flows. The result of these serendipitous circumstances is that, without any special management of runoff, the 100-year runoff event will not exceed the pre-development event at that monitoring station (Thurston County, 1995). However the Woodland Creek situation is far from the norm. Indeed even on Woodland Creek, stations downstream of Long Lake having poorer soils and more intense land use in the tributary area are seeing higher flows with urbanization.

DO CURRENT MANAGEMENT STRATEGIES SHOW PROMISE FOR HABITAT PRESERVATION?

The Washington State Department of Ecology *Stormwater Management Manual for the Puget Sound Basin* (The Technical Manual) is the standard all jurisdictions in the Puget Sound Basin are supposed to adhere to. It provides a process for determining "pre-development runoff" for "existing condition" land use" which is the basis for calculating future allowable discharge. "Existing condition" DOE defines as the land use at the time of permit application. Thus any permit application for development of land that is already in current urban use will never have to meet a higher standard than the one it had to adhere to originally. For most of urbanized western Washington no standards (effectively) were in place when development took place. Thus, with the definition of one word, DOE has determined that there will never be an improvement in hydrology in areas that are currently urbanized (if jurisdictions choose to use the DOE standard).

But let us examine the case where the existing condition is forested. The Technical Manual requires that pre-development runoff be calculated using the SCS (US Soils Conservation Service) formula and that post-development runoff rate shall not exceed the pre-development runoff rate. The formula is as follows:

$Q = (P_r - 2*S)^2 / (P_r + .8*S)$

Where:

Q = runoff depth in inches
P_r = precipitation depth in inches for the period of interest
S = (interception of rainfall by vegetation etc.)

where S = (1000 / CN) - 10
and CN is an empirically derived coefficient based on soil type and land use.

Using this formula one can calculate "pre-development" runoff for Type C (the typical) till soils in King County (CN = 76). For a storm event of say 4 inches, about a 10 year event in the King County area, this calculates to about 1.7 inches of "pre-development" discharge.

What is wrong with this analysis? The interpretation of the results of this calculation made by developers and the plan checkers at local jurisdictions is that 1.7 inches of classical Hortononian over-land flow was the pre-development condition and all that has changed by development is that runoff is coming off the land faster.

This methodology (and underlying assumptions) in one form or another has been used for decades in the design of storm drainage facilities. The tacit assumptions behind this calculation are totally spurious. Many have shown that classic Hortonian over-land flow in the natural state is exceedingly rare. One of the clearest explanations is given by Leytham (Northwest Hydraulics, 1990). To base development drainage design on such an assumption leads to many errors. Among the many changes these false (tacit) assumptions have caused in natural systems, the following are a few examples:

- Increases of peak flow in receiving waters by factors up to 10.
- The duration of peak flows are extended
- Loss of channel stability in receiving waters.
- Loss of fisheries and other aquatic life.
- Loss of groundwater recharge needed to feed streams in dry months.

In addition to the enormous increase in runoff created by past and current regulation, streams are doubly threatened because mitigation measures for increases in runoff in DOE Technical Manual (i.e.

required detention volumes) are inadequate. The SCS methodology as described in the Technical Manual yields about 1.5 inches of storage for an average subdivision. It has been estimated that up to 6 inches of storage is needed to mitigate the impacts of having diverted all infiltration typical in a forested condition to surface runoff typical in an urbanized condition (Barker, 1988). If that amount of storage were required as mitigation, perhaps one-third or more of the urban landscape would be detention facilities.

However, the work done by Barker concludes only that peak flows from urbanized areas with massive storage can be reduced to an "acceptably" small increase over the forested condition. But there is no data that indicates that even a six inch storage requirement would totally mitigate increased runoff. The reasons for doubt include:

- Infiltration volumes seen in the forested condition would still be greatly reduced regardless of the storage provided. This would tend to reduce groundwater return flows that keep streams flowing in the dry months.
- Duration of peak flows would be longer (days instead of hours) in the urbanized condition than the forested condition. The effect of longer duration of peaks is largely unknown but evidence exists that the energy working on the banks would be deleterious to habitat (Fuerstenberg, 1992).

Even if increased detention could mitigate the effects of peak flow increases, water quality deterioration associated with urbanization might take over as the critical parameter even if runoff could be mitigated by detention.

IS THERE EVIDENCE THAT A LEVEL OF DEVELOPMENT CAN BE TOLERATED WITHOUT SERIOUS IMPACT TO FISHERIES HABITAT?

The author knows of no examples of streams on poor soils in the Puget Sound Basin that have not suffered severe damage after the onslaught of urbanization in the watershed. Furthermore the BMPs listed in the Technical Manual show little promise for preserving streams in the future. The author sees nowhere to look for evidence that streams within the Urban Growth Boundaries established in the Puget Sound Basin will not be rendered totally dysfunctional as a result of development even in the unlikely event that current regulations are perfectly implemented. The author sees nowhere to look for examples where urbanization and quality habitat can co-exist given the traditional approach to development.

IS THERE NO HOPE THEN?

The model for urban development compatible with fish survival does not seem to exist. But perhaps a model can be found elsewhere. It is suggested that the experience in forestry management points to an answer.

Urbanization aside, merely to clear-cut log a watershed leaving no riparian buffers can lead to dramatic declines in fish habitat. (Is it any wonder that urban development, akin to paving a clear-cut, will have an even greater impact?). The impact of clear-cut logging practices on streams have been chronicled in the literature for decades. However, also to be found in the literature are examples where logging practices have had impacts within the range that can be tolerated by fish.

For example in the Alsea Watershed on the coast of Oregon the long term impacts of clearcutting vs. patch cutting were compared in a 15-year controlled experiment (Hicks, 1991, reporting work by: Hall and Lantz, 1969; Moring and Lantz, 1975; Hall et al, 1987). In the experiment, Needle Creek was clear-cut to the banks of the stream and Deer Creek was patch cut with buffers along the main channel. Results are summarized in Table 2 below:

TABLE 2 **STREAM IMPACTS OF PATCH CUT VS CLEARCUT**		
	IMPACTS AFTER LOGGING	
CRITERIA	**CLEARCUT (Needle Branch)**	**PATCH CUT (Deer Creek)**
Sediment	Five fold increase	Little change
Gravel permeability	Substantially reduced	Little change
Numbers of migrant fry leaving headwater streams	Half pre-logging value	Little change
Summer temperature	Large increase	Little change
Dissolved oxygen	Substantial reduction	Little change

From Table 2 it seems clear that if urban development could be made to emulate patch cut logging in a watershed, impacts could be minimized. Can this be achieved? The following problems must first be overcome if such a philosophy for drainage control in future development were to succeed:

- Substantial buffers on the stream and tributary branches down to Type 5 channels must be preserved in public ownership. The view of such preservation by lawmakers must change from a "taking" of private property to necessary public dedications with all the validity and acceptance of road dedications.
- All runoff must be infiltrated (similar to runoff from patch cut logging operation). That is to say that whatever the actual impervious surface area of development, its "effective impervious area" must be reduced to zero. The notion of "pre-development discharge" must be abandoned as a methodology for design.
- All obstacles to implementation of new regulations must be overcome and the new regulations implementing such a philosophy must be in place within a few years or there will be no streams inside the urban growth boundaries in the Puget Sound Basin left to save.

Although the author has listed only three problems, these are substantial problems with layers of difficult sub-problems; and their solution would lead to radical changes in the appearance of development.

As an example of a problem to solve, infiltration of runoff from large areas of impervious surface on till soils is a daunting task. Infiltration facilities on such soils are not even allowed by the King County Drainage Design Manual because such facilities are prone to failure. To have any hope of success, such an undertaking would require a completely new approach to designing urban features. Changes would include:

- Radically reducing impervious surface (narrow, one-way roads, non-pervious pavements, multi-story, small-footprint structures).
- Don't collect runoff (e.g. no rain gutters on homes, long infiltration trenches on each home site and next to each roadway, no storm drains (if you collect runoff in any volume on till soils you probably have already failed in the goal to infiltrate)).

- Leaving and/or replanting of substantial numbers of trees (probably calling for protective covenants on property sold).

The implementation of any such design changes will be met by stiff resistance from parties ranging from fire marshals to pavement contractors.

It is hoped that the challenges presented in this paper do not appear insurmountable, for it is the author's belief that the impacts of urbanization must be no greater than patch-cut forest practices, and that there is no other hope for salmon in urban streams.

Discussion

Q: In comparison of the two watersheds, is equivalent clear cut area roughly the same between two watersheds?
A: I do not remember the areas of the watershed.

Q: If you spread out logging over a wider area, you need more roads. This is a big culprit in sediment loading. Wouldn't you be creating a bigger problem?
A: Yes, this is an important point, especially if sediment from the eroding road bed goes directly into the stream. Often a ditch on the uphill side of a forest service road collects runoff and puts it directly into the stream. Don't collect runoff! If you collect it, it creates a problem.
Q: How do you avoid that problem if you take that model and translate it to subdivisions - we have more paved areas in subdivisions.
A: We have to infiltrate it, instantly, at the edge of the road. No curbs.
Q: Are there examples of that functioning?
A: No.

Q: Patch cutting is promoted as an ideal situation to disperse water in a forestry setting. What would a conventional urban system serving that function be?
A: Cluster development is similar, but it has to occur where the fish want it - away from streams. The small channels are extremely important, and they have to be buffered as well. After they are buffered, you cannot hard pipe them - and we have to infiltrate all runoff.

Q: Re: total vs. effective impervious area - is the pavement the problem or is it the collection system?
A: The problem is with the collection system. You can have impervious area, but if your effective impervious area is zero, the pavement doesn't hurt you. The problem is that on till soils, it does not take much pavement to overwhelm what little infiltration capacity you have until you hit the hard till layer. The paradigm shift you have to make is that you have to greatly reduce impervious area so that you can get it into the little bit of soil that exists over the till.

Q: We are trying to work with engineers at the municipal level to get them to avoid putting in traditional drainage systems and to put swales on lots, etc. It is not going well. Do you have any suggestions about how do dialogue with people who are concerned about safety issues, etc.
A: It is difficult. It takes ten years to know when you make mistakes. You need to start with a drainage ordinance. You can point to the Department of Ecology manual that says that gutters and curbs collect runoff, therefore you cannot have them (on till soils).

Q: What if we put development on outwash soils? This makes sense for infiltration purposes, but what are the implications to groundwater?

A: Spokane has 100 years of experience with that. They are sitting over an aquifer. They estimate that there is about 1/4 million gallons of oil being dumped on the soil each year. They cannot find it in the groundwater. The aquifer could be so large that it can accept a lot of pollution or perhaps the oil is sitting in a three inch layer on the top of the aquifer. “Urbanization is not for sissies.”

SESSION 2: PROTECTION

Chair: Eric Bonham, B.C. Ministry of Environment, Lands and Parks

EVALUATION OF THE EFFECTIVENESS OF THE URBAN REFERRAL PROCESS IN PROTECTING WATER QUALITY AND FISH HABITAT IN BRITISH COLUMBIA
Melody Farrell - Fraser River Action Plan, Fisheries and Oceans Canada

RIPARIAN VEGETATION EFFECTIVENESS
Andy Castelle - Adolfson Associates

IMPACT OF STORMWATER RUNOFF ON URBAN STREAMS: A CASE STUDY IN THE BRUNETTE RIVER WATERSHED
Ken Hall - University of British Columbia, Institute for Resources and Environment

NON-POINT SOURCES OF POLLUTION FROM RURAL/URBAN FRINGE ACTIVITIES
Hans Schreier - University of British Columbia, Institute for Resources and Environment

EROSION AND SEDIMENT CONTROL: NEXT STEPS TOWARDS CONTROLLING EROSION AND MANAGING SEDIMENT
Barry Chilibeck - Habitat Enhancement Branch, Fisheries and Oceans Canada

STORMWATER QUALITY CONTROL
Louise Kulzer - King County Department of Natural Resources

KING COUNTY SURFACE WATER DESIGN MANUAL - STREAM PROTECTION DETENTION STANDARDS
Kelly Whiting - King County Department of Natural Resources

URBAN STREAM PROTECTION: FROM BYLAWS TO PARTNERSHIPS
Julia Gardner, Dovetail Consulting

EVALUATION OF THE EFFECTIVENESS OF THE URBAN REFERRAL PROCESS IN PROTECTING WATER QUALITY AND FISH HABITAT IN BRITISH COLUMBIA

Melody Farrell - Fraser River Action Plan, Fisheries and Oceans Canada, Vancouver, B.C.

ABSTRACT

The Ministry of Environment, Lands and Parks (MELP) and the Department of Fisheries and Oceans (DFO) have the legislative mandate to protect the fisheries resource, aquatic habitat, and water quality in British Columbia. This environmental management mandate extends to small urban watersheds where urban development proposals have the potential to significantly impact fish habitat and water quality. DFO (Habitat Management Sector) and MELP (Fish and Wildlife (F&W) Management, and Water Management Branch (WMB)) become involved in development proposals through the urban referral process, whereby they provide approval conditions pursuant to their legislation, policies and guidelines.

This study evaluates the effectiveness of the urban referral system; i.e. it assesses how well the referral process is protecting fish habitat and water quality. Effectiveness was assessed by determining the level of compliance with the senior environmental agencies' referral approval conditions in five study watersheds over a ten year period (1985-1995). The study area watersheds were located in the Lower Mainland (Bear and Hoy Creeks), the east coast of Vancouver Island (Departure Bay and Willow Creeks), and the Okanagan (Kelowna (Mill) Creek).

The urban referral files for each watershed were reviewed to determine the agencies' requirements for each site. Water Management Branch referrals (e.g. instream works, water licenses), municipal government referrals (e.g. rezoning, subdivision, building permits), and higher level planning referrals (e.g. official community plans) were reviewed. Following the file review phase each site (or a representative sample of sites) was visited in the field. Compliance with the relevant approval conditions was assessed using standardized evaluation forms. A summary of the findings are as follows:

Watershed	**Overall Project Compliance (% of projects falling into each category)**			
	Compliant	**Minor non-compliance**	**Significant non-compliance**	**Compliance cannot be determined**
Bear Creek	24%	4%	64%	7%
Hoy Creek	40%	9%	38%	13%
Willow Creek	15%	27%	50%	8%
Dep. Bay Creek	25%	15%	25%	35%
Kelowna Creek	38%	14%	33%	14%

The results of this study demonstrate that although compliance with the referral approval conditions of the senior environmental agencies varies between watersheds, the range of non-compliance with approval conditions is significant for all watersheds. Therefore, the effectiveness of the urban referral process in protecting fish habitat and water quality is limited.

This study also suggests that there is significant variation in the type and rigor of approval conditions issued in each of the geographic regions investigated as part of this study. We note that this is quite independent of the level of compliance with these approval conditions.

A series of recommendations pertaining to regional management approaches, monitoring and enforcement, technical/biological issues and requirements, and respective government roles are outlined in the final section of the report.

Questions for discussion:

- Are we achieving NNL using this process?
- What are the implications of this to revisions to the National Habitat Policy? How do we strengthen the National Habitat Policy?

Speaking Notes:

I. Purpose

1. Evaluate the effectiveness of the urban referral system.
2. Assess the implementation of project approval conditions.

II. Background

- System established in 1970
- Provides review / approval process
- First formal evaluation

III. Types of Urban Referrals

Three types of referrals were evaluated :

- Water Management Branch
- Municipal government
- Higher level plans

IV. Study Areas

The study focused on projects undertaken in five watersheds between 1985 - 1995

- Bear Creek (Surrey)
- Hoy Creek (Coquitlam)
- Departure Bay Creek (Nanaimo)
- Willow Creek (Campbell River)
- Kelowna (Mill) Creek (Kelowna)

V. Methods

Phase 1 - File Review

The following types of referral files were reviewed for each watershed :

- Subdivisions
- Rezoning
- Building permits
- Higher level plans
- ***Water Act*** applications

Files were chosen for review based on :

- Size
- Watershed distribution
- Proximity to mainstream or large tributary
- Approval / project timing
- Instream and Land Development Linkage

Phase 2 - Field Program

1. Watershed health assessments
2. Project compliance analysis
   - Setback / Leavestrip
   - Construction / site development practices
   - Storm water management / detention
   - Engineering requirements

V. Watershed Analysis

Bear Creek

- 25% EIA from 1985-95
- Significant Riparian loss
- Loss of wetted area
- culverting
- Infilling
- bank stabilization
- Significant WQ concerns
- Local stewardship groups

Hoy Creek

- Prior to 1990 lower reaches commercial
- WESTWOOD PLATEAU (1991- present)
- Loss of habitat
- Riparian
- WQ
- Local stewardship group

Willow Creek

- < 10% urban development, majority-timber reserve
- Residential (lower 1.5km)
- Chum loss coincided with 1950's water storage dam (removed 1961)
- Some projects not referred
- Significant local stewardship activity

Departure Bay Creek

- Virtually 100% developed (pre 1985)
- Early development to t-o-b
- EIA from 1985 - 1995
- Many projects not referred
- No local stewardship groups

Kelowna Creek

- Development concentrated d/s of airport
- Significant loss of habitat
    1. Channelization
    2. Bank Protection
    3. Culverts
    4. Riparian clearing
    5. Diversions (>3.2$m^{3/s}$ diverted to Mission Crk)
- Enhancement efforts failing due to sediment inputs (1988)
- No local stewardship groups

VI. Conclusions

- Effectiveness of the referrals is questionable
- Non-compliance is significant for all watersheds
- Full compliance does not equal full protection

Most deficiencies result from :

1. Variations in process
2. Variations in conditions and standards
3. Type and level of monitoring & enforcement
4. Willingness to comply with approval conditions

VII. Recommendations

<u>Regional</u>

- Establish standard referral framework
- Collective endorsement and promotion of NNL and LDG
- Conduct information exchange workshops

<u>Monitoring</u>

- Use independent monitors
- Require monitoring reports
- Track monitoring reports
- Follow-up non-compliance

<u>Enforcement</u>

- Use bonding and securities
- Increase priority for enforcement by COs / FOs
- Develop regional enforcement strategy

<u>Technical / Biological Issues</u>

- Develop detailed application package
- Require EIAs for all large projects
- Adopt a standardized riparian protection approach
- Explore new BMPs
- Address cumulative environmental impacts
- Continue emphasis on education and awareness

<u>Municipal Role</u>

- Develop new approaches
- Formalize monitoring and enforcement functions

<u>Ministry of Municipal Affairs Role :</u>

- Designate OCP specialists
- Provide municipalities with model stewardship bylaws

Discussion

Q: What is the incentive to developers to comply with the guidelines?
A: The incentive is that we can shorten the development review time, if a) we get the process in place, b) make sure we have a way to screen the referrals, c) provide standardized conditions and standards, and d) developers are advised early enough in the process. Then we know that our objectives are being met and we can focus our efforts on those that are seeking variances or are non-compliant. If we can make the process more effective and efficient, there is real incentive. There is also an incentive of avoiding prosecution.

Q: Have you ever had a prosecution?
A: Yes, there have been several.

Comment: It is more helpful to get out of confrontational mode and stop talking to developers about compliance. We need to create a win-win situation, to make it worth their while, time wise and economically. We should work with developers earlier in the process, fast track applications, use density bonuses, etc. This approach will work better.

Comment: We started to make compliance with the guidelines a condition of approval, like engineers do, before they can get their bond. It is working well.

RIPARIAN VEGETATION EFFECTIVENESS

Andrew J. Castelle - Adolfson Associates, Seattle, WA

ABSTRACT

A common method of reducing or eliminating impacts to streams from nearby land uses is to maintain "buffers" adjacent to the streams. Buffers are vegetated zones located between natural resources (streams, wetlands, or critical wildlife habitat) and nearby areas subject to human alteration. In some locations, buffers are known as "vegetated filter strips" (VFS). The emphasis on the filtering function of vegetation is derived from their widespread use to remove sediments and other waterborne pollutants from the surface runoff.

The objective of this study was to examine the effectiveness of riparian vegetation in maintaining riparian function and to graphically summarize relationships between buffer size and vegetation effectiveness. This report consists of an extensive literature review and specifically examines the effectiveness of vegetation in providing six riparian functions, chemical removal, and three "source" functions - large organic debris (LOD) production, particulate organic matter (POM) production, and shade production for stream water temperature moderation. Vegetation effects on these functions are mostly described in terms of distance from stream bank expressed in meters; where appropriate, other metrics are used (such as root density or tree height). Our specific emphasis is the effectiveness of riparian vegetation function in silvicultural areas; however, useful results from studies conducted in agricultural areas are also reported.

Riparian vegetation sink functions generally increase with increasing buffer width. With respect to sediment trapping and chemical removal from runoff, most of the benefits of riparian vegetation are manifested within the first five to 25 meters. At least 50% effectiveness, and in some instances, and effectiveness of 75% or greater occurs in buffers of this width. Disproportionately wider buffers are needed to achieve greater effectiveness. However, sediment trapping and chemical removal varies not only with the width of the vegetated area, but also depends on other factors. For example live trees promote infiltration and evaporation, thus reducing runoff, while downed trees may provide a significant barrier to sediment movement. The other sink function, streambank stability, is not a function of buffer width. Instead, streambank stability was found to be a function of fine root density within the bank itself, in addition to a function of several intrinsic soil parameters.

Source functions of riparian vegetation were found to be generally higher near streams and decreased with increasing distance from the stream. Vegetated buffers of up to 25 meters in width provide significant LOD, POM, and shade production. As with the sediment trapping and chemical removal curves, disproportionately larger buffers are needed to increase percent effectiveness for these functions about 75% to 95% or greater. Additionally, other site factors, such as flood-prone width, soil physical properties, and sideslope gradient above the stream were found to be important in maintaining riparian function. In some instances, these physical characteristics may be a larger determinant of stream protection than vegetative metrics.

Discussion

Q: Did your data sources include a multitude of buffer types?
A: Yes - there was everything from forested buffers, to grassy strips in agricultural areas, to mixed urban buffers.

Q: Did you develop curves for other values, such as wildlife?
A: No, that was not our task for this project

Q: Re: shade production and canopy cover. How does it relate to air temperature and humidity level?
A: We found that direct sunlight was the most important factor. Humidity was not a big consideration in the literature.
Q: So, higher levels of shade do not necessarily lower the temperature?
A: They do not necessarily lower the temperatures, but they maintain the temperatures.

Q: When you refer to a 100 metre buffer, do you mean 100 metres on each side of the stream?
A: Yes, we focused on the buffer on each side. In an urban environment, there are often different types of land uses on opposite sides of a stream. We focused on the specific needs of the buffer.

Q: I can see that if you are doing restoration or enhancement, you want to focus on your higher quality streams, but if we use a hierarchy, i.e., reducing buffer area on lower quality systems (which are the majority of the systems), would we not have a greater threat to fish survival and population numbers? There are many more smaller streams, thus they produce more fish on the whole.
A: Instead of putting individual streams into a class, you could look at the smaller streams in a certain area. The high number of low grade streams could raise the rating to a higher class, thus higher priority.
Alan Johnson often says that the urban setting is much like flour - we take all the good nutrients out of the flour, then put a few vitamins back in and call it enriched flour. We do this in the urban setting - we take what were well-functioning, diverse habitats, then add a little bit back and call it enhancement.

IMPACT OF STORMWATER RUNOFF ON URBAN STREAMS : A CASE STUDY IN THE BRUNETTE RIVER WATERSHED

Ken Hall - University of British Columbia, Institute for Resources and Environment, Vancouver, B.C.

ABSTRACT

The water quality of 13 stream stations and 4 street runoff stations were investigated over a two year period in the Brunette watershed in Burnaby. The focus was on documenting metal and organic contamination, nutrient and microbial pollution. The result showed excessively high levels of fecal coliform in several creeks, especially Still Creek where domestic wastewater enters the stream system. This severely restricts the recreational use of many areas in this urban watershed and is of serious concern for fish health. High concentrations of contaminants were also measured during storm events when trace metals, nutrients, and organic compounds reached levels in excess of water quality objectives. The contamination is primarily associated with vehicular traffic and the pollutants that accumulate at the street surfaces enter the stream during storm runoff events.

A direct correlation was found between traffic density, land permeability and loadings of contaminants in street runoffs. Storm runoffs analysis demonstrated that Cu, Pb, Mn, Zn, and hydrocarbons were the major contaminant sources that enter streams mainly in association with the suspended sediment load. Storms during the summer occurring after extended dry periods showed higher contaminant concentrations than occurred during frequent storm events with shorter dry period intervals during the winter. Microtox bioassays indicated that the suspended solids were toxic. In order to protect aquatic life a number of steps need to be taken to reduce Cu and Zn levels and organic constituents which were above water and sediment quality criteria. To protect the aquatic biota significant changes are needed in control and management of contaminants generated in urban watersheds. The policy options for this non-point source pollution problem include best management practices, sediment traps, stormwater detention ponds, source control, regulations, and changes in the transportation system.

NON-POINT SOURCES OF POLLUTION FROM RURAL/URBAN FRINGE ACTIVITIES

Hans Schreier - University of British Columbia, Institute for Resources and Environment, Vancouver, B.C.

ABSTRACT

To protect and rehabilitate fish habitat in rural/urban fringe areas, a number of issues need to be addressed. They range from modification of streamflow due to the creation of impervious surfaces, to water pollution. The former results in a more flashy stream system leading to greater bank instability problems and higher suspended sediment loads while pollution concerns relate to excess chemical inputs. The focus of this presentation is on non-point sources of water pollution. Excess metal and organic contamination will be discussed by Hall and the focus of this paper is to show the problems associated with excess nutrients. Most urban streams have their headwaters in rural environments or forests and the activities in the rural fringe area have significant impacts on water quality. These include excess nitrogen and phosphorus inputs, acidity, and bacterial pollution. The impact of microbial problems and excess nutrient concentrations lead to ecosystem and human health deterioration. A case study from the Salmon River Watershed in Langley is presented to:

1. Illustrate how GIS based methods can be used to assess the problem;
2. Document the source and extent of the pollution problem; and
3. Provide policy options to reduce and mitigate the problem.

The majority of the inhabitants of the watershed receive their drinking water from local aquifers which are also the major source of streamflow during the dry summer months. Septic systems, hobby farms and intensive agricultural enterprises are the main sources of excess nutrients that result in groundwater contamination. This is leading to excess nitrate concentrations in the stream during the summer and phosphate and bacterial problems during the winter. Based on groundwater surveys it was shown that land use intensification has led to these problems. All of the contaminant sources are dispersed and it is very difficult to show individual impacts on water resource contamination. However, the cumulative effect can be shown by linking GIS based historic land use analysis with stream monitoring data. Extent and Change over Time: About 1/3 of the main aquifer in the watershed is impacted by nitrogen contamination and, depending on the time of year, between 3 - 13% of the well water sampled had nitrate values above drinking water health standards. Similarly, coliform counts in streams reached levels which exceeded recreational use standards during the late fall period. The sources of the nitrogen contamination were identified with GIS as 48% originating from commercial agriculture, 34% from septic systems, and 18% from hobby farms. There is clear evidence that nitrate values in the stream have increased significantly over the past 20 years in area that are highly influenced by groundwater. Unfortunately, insufficient historic groundwater data is available to show the rate of groundwater deterioration over the same time period.

Current Policy Approaches: In the absence of any groundwater regulation it is very difficult to deal with groundwater contamination. The Ministry of Health approves septic systems but once a permit is given there are few means to regulate the management of such systems. Only in extreme cases of system breakdown can health officials interfere and in all cases they have to show direct cause and effect. Agricultural management on aquifers is regulated by the Ministries of Agriculture and Environment and the Ministry of Health has little jurisdiction in that area. Also, it is often unclear under whose jurisdiction hobby farms fall. Clearly, aquifer pollution problems are multi-

sources and multi-jurisdictional and a new policy is needed to avoid further contamination of aquifers. This is particularly important because there are few successful and feasible technical solutions that can decontaminate groundwater.

Suggested policy actions:

1. Integrate groundwater regulation.
2. Source control (initiate a by-law).
3. Start education programs on septic systems management and hobby farm management.
4. Enforce best management practices for septic system and hobby farm management.
5. Restrict land use activities on unconfined aquifers (reduce septic system density, hobby farm stocking density).
6. Apply different regulations to unconfined aquifers.
7. Incentive programs for moving waste away from unconfined aquifers.

Discussion

Q: Is your presentation available on CD-ROM?
A: It fits on four floppy disks. We distribute it freely. If you want a copy, let us know.

Q: How applicable is your work on sources to other watersheds?
A: We did a similar modelling exercise on the Sumas watershed, which is completely agricultural. It is a complex situation, mainly because it is an international watershed. There are different rules and regulations, etc.

Q: Can you use the model for other watersheds (other than the Salmon River watershed)?
A: Each watershed has its own idiosyncrasies, so we should not extrapolate directly from one to the other. The approach could be applied, however.

Q: Why were hydrocarbons high in the Nootka residential area, if it is not a high traffic area?
A: It could be because of the large parking areas in the residential area. Leaky crank cases can be a problem - the rain washes it off the pavement and into the streams. It would be nice if Air Care took a closer look for such leaks.

EROSION AND SEDIMENT CONTROL: NEXT STEPS TOWARDS CONTROLLING EROSION AND MANAGING SEDIMENT

Barry Chilibeck - Habitat Enhancement Branch, Fisheries and Oceans Canada, Vancouver, B.C.

ABSTRACT

Since the implementation of the Land Development Guidelines, erosion and sediment controls have been implemented on many development sites through conditions of approval from agencies or local governments. As a result, the number and frequency of reports of sediment discharges to local streams have dropped significantly.

The technologies utilized in erosion and sediment control plans (ESCP) have not changed significantly, and still rely on relatively simple techniques and materials. However, like modern construction practices, the planning and assessment tools available are increasingly important to ensure that proper practices are used in a cost-effective manner.

The direction of future erosion and sediment control is to look upstream of the sediment control pond and focus primarily on source control. This will be accomplished through the collection of proper information prior to development, effective assessment and design, implementation of BMPs, maintenance and monitoring.

Speaking Notes:

Erosion and Sediment Control in B.C.

- Overview of B.C. situation
- Problems and Solutions
- "Re-engineering" of Erosion and Sediment Control in the Land Development Guidelines
- Wrap-up and Questions

Why Control Sediment?

- Impacts to fish and fish habitat
- Impacts to Infrastructure
  - Clogged drains
  - Infilled catch basins
  - Soiled streets
- Increased Maintenance and Costs

- Labour costs (clean-out crews)
- Street sweeping

- Legal Responsibility
  - Liability of the owner
  - Liability of the contractor

Physiological Effects on Fish
- altered blood chemistry
- reduced feeding efficiency (sight feeders)
- induced avoidance in water column
- reduced growth rate (feeding related)
- gill trauma (75 micron particle size) and reduced respiratory efficiency (gulping)
- decreased disease resistance

Physical Effects on Fish
- egg mortality (reduced DO and suffocation)
- alevin/larval mortality (trapping)
- displacement and increased predation
- juvenile/adult fish mortality (gill damage)

Physical Effects on Fish Habitat
- reduced primary and secondary productivity due to turbidity (light)
- macroinvertebrate drift and recovery lag (fish food items)
- reduced gravel porosity (spawning habitat)
- infilling and sedimentation of habitats for fish and food organisms resulting in loss of use, displacement and reduced survival
- morphological change and degraded gravel structure (long-term)

Suspended Sediment Criteria: EIFAC (1965)

SS Level (mg/L):	"Fisheries" Effect:
< 25 mg/L	none
25 - 80 mg/L	slight
80 - 400 mg/L	significant
> 400 mg/L	overwhelming

- Current guideline levels are 75 mg/L above background.

Suspended Sediment Criteria: B.C. Ambient Water Quality Guidelines and CCME (1994)
1. non-filterable residue 10 mg/L when background non-filterable residue is 100 mg/L
2. non-filterable residue 10% of background when background is > 100 mg/L
3. no deposition of particles < 3 mm diameter in salmonid spawning areas

- Current guidelines do not limit discharge of "settleable" sediments.

Suspended Sediment Criteria: Yukon Placer Authorization (1993)

Stream Type:	SS Level (mg/L):
Type I & V	0 mg/L
Type II	< 200 mg/L
Type III	< 200 mg/L
Type IV	stream specific

Stream Type:	Habitat:
Type I & II	chinook
Type III	grayling
Type IV	nuked
Type V	no information

Suspended Sediment Criteria: Land Development Guidelines (1993)

1. < 75 mg/L above background wet weather flows
2. < 25 mg/L above background dry weather flows
3. 0 mg/L above background salmonid spawning habitat

- Is 0 mg/L achievable?
- Is background acceptable in disturbed watersheds?
- Cumulative effects?

Newcombe Concentration - Duration Model

The natural logarithm of the product of dose (mg/L) and exposure (hours) gives a severity-of-ill-effect scale or SE:

Event SE:	Impact:
SE = 0	No Effect
SE < 3	Behavioral Effects, Temporary Habitat Damage
3 < SE < 9	Sub-Lethal Effects, Habitat Damage
9 < SE < 14	Lethal Effects, Severe Habitat Damage
SE >14	Supra-Lethal Effects, Catastrophic Habitat Damage

75 mg/L for 24 hours = 7.5

Dose - duration applications:

- determine potential scale and nature of impacts
- direct further investigation, monitoring or remediation
- cannot predict actual impact, therefore cannot determine effluent criteria for suspended solids

Negative Aspects of Fixed SS Criteria:

- substantial natural variation in sediment levels, sediment availability and transport in stream systems is variable
- large range of acute (lethal) to habitat effects over biota species, lifestage and size
- sediment size, angularity and other external factors impacts
- recognized impact is a function of dose (concentration) and duration (time) of impact

Positive Aspects of Fixed SS Criteria:

- maintains a suspended sediment near natural regime to which aquatic organisms are normally subjected or have adapted
- independent of time, partially independent of location
- one level accommodates least sensitive biota and therefore potential for ecosystem protection

Criteria for Suspended Solids Discharges

- 50 mg/L above background into fish-bearing waters or waters directly discharging into fish-bearing waters
- no discharge of settleable solids as determined by standard Imhoff cone test (0 mL/L standard)
- permanent drainage flows shall not discharge suspended sediment levels (NFR) greater than those recommended by CCME guidelines

Problems with Current ESC Strategies in B.C.

1. Current ***Land Development Guidelines*** practices are specification-oriented, for large development sites and controlled development practices.
2. No directed guidance on site level erosion and sediment controls.
3. Current ESC ***best management practices*** (***BMPs***) are based on 1970s technology.
4. Current ESC planning practices are based on ...
5. ESC implementation has been "pond-centric".
6. Not enough focus on managing water - on and off the development site.
7. Insufficient detail for non-structural ***BMPs*** for development sites.
8. Lack of integration with local government processes and programs.
9. Identifies tools, but not the processes.
10. Liability and responsibility need to be defined.

Erosion and Sediment Control in the *Land Development Guidelines*

1. Re-focus **design objectives on Prevention.**

Fit the site to the natural grade and topography by incorporating ESC objectives into building/site design process:

- terrain and site planning
- access design
- building axis location and orientation
- building type and use

2. Make it a **requirement to assess site conditions** prior to development:

- building envelope and maximum disturbance area
- vegetation cover
- topography and drainage
- soil erodibility
- precipitation and climate
- season and timing
- erosion/sediment control bmp prescriptions

using the ***universal soil loss equation*** as an assessment tool.

Use ***Site Fingerprinting*** to limit disturbed area:

Allow a maximum disturbance area equal to the building envelope, working area and access right-of-way:

MDA = BE + WA + ACCESS

and all other areas left undisturbed or effectively revegetated until final landscaping.

Require **minimum natural area or vegetation retention**:

- mitigate EIA watershed effects
- wildlife values
- incorporate leave area requirements
- reduce disturbed area

based on predevelopment assessment, lot size, land-use (zoning).

Example:
Leave or vegetation retention areas could be required on:
· all perennial and intermittent streams
· all wetlands and groundwater discharge/recharge areas
· critical wildlife areas
· wildlife trees and buffer areas
· slopes over 30%
· hydric and highly erodible soils (K value > 0.35)
· 1:100 year floodplain
· all geotechnical hazard areas

Universal Soil Loss Equation is a semi-empirical predictive relationship:

A = R • K • LS • C • P

where:
A: soil loss (tons/area/event)
R: rainfall factor (10 - 300)
K: soil readability factor (0.02 - 0.69)
LS: length-slope factor (.06 - 134)
C: vegetation factor (.05 - 1.0)
P: erosion control factor (0.8 - 1.3)

· **Soil Erodiblity**: identify and assess potentially erodable soils on the site.

ML>SM>MH>SC>OL >> CL>CH>OH>GM>GP>GW

· Importance of C and LS factors:
Apre = R•LS•K•C•P
Adev = R•LS•K
(C = 1.0, P = 1.0 with no controls)
% Effectiveness = Apre - Adev / Apre
% Effectiveness = (1- C•P)

soil loss depends on the vegetation retained (C) and length-slope (LS) because these are the manipulated factors on the development site.
· Should assessment be based on percentage effectiveness?

3. Effective erosion control includes surface erosion and channel erosion. Critical water drainage factors to reduce erosive energy are:
· **Decrease** - decrease run-off volumes
· **Detain** - reduce run-off velocity
· **Divert** - reduce the length of slopes
· **Dissipate** - spread out the run-off

4. Ensure competent design and implementation through use of Erosion and Sediment Control Plans (ESCP) approved by a certified ESC professional or P.Eng.

5. Enlist the support of the building contractor. Erosion control is an order of magnitude more effective and, in the long-term, are less expensive. Sediment control has substantially higher maintenance costs.

6. Ensure (ideally) sequenced construction:
· install temporary erosion and sediment control BMPs

- install drainage system
- install temporary roads
- temporary road stabilization / paving
- clear and grade buildable lot area
- building construction
- permanent erosion control / landscaping
- hook-up to permanent stormwater BMPs

Most Common Erosion and Sediment Control Problems
New Principles for Erosion and Sediment Control

1. ***Be Practical -*** "It is not rocket science"
2. ***Know when a BMP is not a BMP -*** straw bales…and only straw bales
3. ***Use the right tool for the job -*** balance site area to proper BMP
4. ***Give and receive credit where due -*** erosion protection in lieu of structural BMPs
5. ***Minimize off-site impacts -*** most drainage designs concentrate run-off
6. ***Think multi-purpose -*** bioengineering techniques are adaptable and often ideal
7. ***Keep run-off out of the site*** - less water - less erosion - less sediment
8. ***Protect exposed soils -*** vegetation reduces run-off (see above!)
9. ***Replace all top soils*** - most native top soils contain a large quantity of native seeds and nature knows best
10. ***Minimize soil compaction*** - limit machine finishing on slopes
11. ***Keep it rough*** - roughened soil traps water and seeds, provides infiltration
12. ***Protect storm drainage system*** - seal off catch basins
13. ***Expand your tool box*** - on-site compost, donuts, etc.
14. ***Re-evaluate current practices*** - native plants will typically survive better on less water and fertilizer
15. ***Maintenance***

Discussion

Q: How do you convince a developer to clear only the area of the building envelope, when he thinks he needs to clear the entire area.
A: Get the developers to provide the logic behind their plans.

Comment: Municipal use of sanding creates a lot of sediment - it is not just development.

Q: We are re-vamping the Land Development Guidelines, but until municipalities incorporate them into their by-laws, we will not get very far. It has to be standardized across municipalities.
A: Master municipal construction documents exist. The environmental and geotechnical packages that are part of that are excellent. It is best for municipalities to provide guidelines on the geotechnical and environmental conditions in their own area. They provide a letter to the contractor noting the environmental or geotechnical conditions. But yes, there are no minimum standards. It would be nice if municipalities could develop at least ten items that must be addressed, at a minimum.

Comment: Municipalities have just dealt with ensuring that they are meeting current engineering standards, e.g. underground sewers and water, roads, etc., and now the Land Development Guidelines are being revised.
A: Do you need a massive right-of-way for a 10 inch water main? We need to offer some alternatives in the LDGs. If we can include alternative methods to meeting right-of-way requirements for utilities, let's figure it out.

Comment: Engineers always have a good argument for doing things their way. We do not have a good counter argument.
A: We need to work on examples of where alternative methods have worked.

Q: Will the Land Development Guidelines have clear technical options for working on clay?
A: We will have to do something about that. We cannot just go ahead and develop the same way on various (sensitive) soils. We need assessment and planning to identify those issues and some special practices.

Q: Are you okay with having erosion control plans certified by either a Professional Engineer or an Erosion and Sediment Control professional?
A: Some erosion control plans that come from Professional Engineers are not good. We need to raise the standard of work through a combination of education, awareness, etc. There is liability attached to a Professional Engineer - will they guarantee that a site will stay contained? Perhaps we may need to identify the engineer in a Fisheries Act violation. Much more professional development is needed.

STORMWATER QUALITY CONTROL

Louise R. Kulzer - King County Department of Natural Resources, Seattle, WA

ABSTRACT

Although keeping pollutants out of stormwater is the most effective way to affect stormwater quality, not all pollutants can be addressed by source control measures. Treatment of urban runoff is therefore an important consideration in improving the quality of runoff entering urban streams. There are numerous facility choices for treating runoff including water quality ponds and vaults, biofiltration swales and filter strips, sand filters, constructed wetlands, compost filters, oil water separators, catch basin inserts, and other newer small-scale technology.

Resource managers often ask how well these treatment facilities work. The answer is that it depends on three things:

1. how large the facility
2. how it's designed, and
3. how well it's maintained.

It also depends on what pollutant is being targeted. In my judgement, the pollutants that have the most potential to cause damage in stream systems are total suspended solids (TSS), metals, soap, solvents, herbicides/pesticides/fungicides, and petroleum hydrocarbons. These pollutants differ in size, weight, chemical properties and biological effects. They also differ in their susceptibility to the removal processes found in stormwater facilities. The more typical treatment processes include settling (sedimentation), adsorption and absorption, physical filtration, photolysis, biodegradation, and floatation. Table 1 indicates which of the above named pollutants are likely to be removed by typical stormwater treatment processes.

Table 1 Pollutant susceptibility to various treatment processes

Pollutant	TSS	Metals	Soap	Solvents	Herb/pest/ fungicides	Hydro-carbons
Settling	≠	≠				
Ad/absorption		≠		≠	≠	≠
Filtering	≠	≠				
Photo/biodegradation			≠			≠
Floatation				≠		≠
Other			Deactv.	Volatile		

The treatment processes used by the typical stormwater treatment facility are indicated in Table 2. Few facilities employ all processes, and some are quite process specific. From this information, it becomes easier to understand why pollutant removal performance varies for different facilities.

Table 2 Likelihood of various stormwater treatment facilities removing key pollutants

Pollutant	TSS	Metals	Soap	Solvent	Pest/ fungicides	Hydro-carbons
WQ pond	≠	≠		≠		≠
WQ vault	≠	≠		≠		≠
Biofiltration	≠	≠			≠	≠
Sand filter	≠	≠				≠
Constr. Wetland	≠	≠	≠		≠	≠
Compost filter		≠			≠	≠
O/W separator						≠

Legend: ≠ major process

≠ minor process

___ little effect

Size: Large facilities generally remove pollutants better than small facilities. But how big is large? In general, designing to treat about 2/3 of the 2-year storm (event model) or flow (continuous model) through the active facility treatment area gives good performance on an annual average basis. If sizing is done by volume, providing a volume equal to three times the runoff from the mean annual storm[1] also gives good performance. Facilities very much larger than this are much costlier, and tend to show diminishing returns.

Key design features: Facility design can make or break performance. Some of the common features that affect performance are residence time (or contact time in the case of filtration and ad/absorption processes), control of turbulence, minimizing resuspension, and avoiding dead zones. Designs also must consider maintenance access and cleaning requirements, for if stormwater treatment facilities work, they will become dirty. The trick is to design the facility robust enough to be able to perform fairly well for a reasonable length of time between maintenance episodes. In King County, annual maintenance (or at least inspection) is the goal for publicly maintained facilities.

Sizing, good design and adequate maintenance all affect how well can stormwater treatment facilities can remove pollutants, but effectiveness differs for different pollutants. Table 3 gives realistic annual average removals for the major pollutant types.

One way to get better performance from stormwater treatment facilities is to use a treatment "train" -more than one facility in series. This gives the ability to handle the bulk of sediment in the initial facility and optimize removal of the target pollutant by choosing a second facility that employs the best removal mechanism for that pollutant.

Table 3 Realistic pollutant removal expectations for well-designed stormwater facilities

Pollutant	Annual Average Removal

[1] The mean annual storm is a statistic construct used in the Nation-wide Urban Runoff studies sponsored by EPA in the 1980s. It takes the total annual precipitation and divides it by the number of storm events in the year.

TSS	80%
Zinc	50%
Soap	---- (use source control)
Solvents	---- (use source control)
Pesticides	---- (use source control)
Hydrocarbons	10 mg/L

[King County's best attempt to achieve optimized stormwater treatment facility designs are in Chapter 6 of the February 1996 draft updated proposed for the Surface Water Design Manual. Use of treatment trains for targeted pollutant removal is also advanced. Copies of the February 1996 draft can be purchased from King County Water & Land Resources Division, 206-296-8332.]

Discussion

Q: The large size of stormwater facilities required for 5 acre developments is a strong argument for retention of natural wetlands. Do you have ordinances to protect natural wetlands in Washington State?
A: We do not allow natural wetlands to be used for stormwater treatment. We view them as habitat. Those facilities are there to capture pollutants - it is not appropriate habitat. Do not put nest boxes in stormwater facilities, and do not encourage ducks to come and feed there.

Q: What do you do with the contaminated sediments?
A: We remove the contaminated sediments and use them in roads projects (e.g. underneath pavement) - it depends on the character of the sediment. We do not use the sediments in places like school yards. There are many ways they can be dealt with such that people are not exposed to the sediments.

Q: Who maintains the stormwater management facilities? There is a big issue of maintenance costs here.
A: In King County, commercial facilities are maintained by the owner. Facilities in residential developments are maintained by King County.

Q: Do you have development cost charges in King County to provide money for maintenance of such facilities?
A: We have a general stormwater management fee which is paid by all residents in King County. This may not work for much longer. We also used to inspect commercial facilities until recently - now we do self-certification.

KING COUNTY SURFACE WATER DESIGN MANUAL - STREAM PROTECTION DETENTION STANDARDS

Kelly R. Whiting - King County Department of Natural Resources, Seattle, WA

ABSTRACT

King County Water and Land Resources (f.k.a. Surface Water Management) has been collecting comments and drafting an update to the Surface Water Design Manual over the last six years. The proposed updates, scheduled for adoption in 1997, include many advances in stormwater management, especially in the areas of water quality protection and hydrologic analysis using continuous flow records. The proposed manual includes the following multiple protection levels for flow control and water quality protection which can be targeted to downstream resources.

Levels of Flow Control	Levels of Water Quality
0. Direct Discharge, Urban Infill exempt, no R/D	· **Basic Water Quality** (80%TSS removal)
1. Basic Conveyance Protection Standard match 2,10 peak flows	· **Sensitive Lake Protection** (50% TP removal)
2. Stream/Erosion Protection Standard match high-flow durations	· **Resource Stream Protection** (50%Zinc removal)
3. Lake/Volume Protection Standard match high-flow durations plus 100-year peak flow.	· **Sphagnum Bog Protection** Rare wetlands in King County

***Rural developments may use alternate approach of flow dispersion and forest retention to meet both flow control and water quality requirements.

Other manual changes have allowed increased protection levels to be achieved while reducing the overall costs of stormwater facilities for most residential development. These include simpler facility designs and flexibility in selection of water quality controls including dual-purpose facilities. Developments providing open detention ponds can, in most cases, meet water quality requirements by simply overexcavating the detention pond to provide a permanent wet pool. The basic water quality controls provide good protection of stream water quality when combined with protective buffers and adequate erosion control measures during construction. The stream water quality standard protects against toxic metal conditions for fish but has been targeted to only the most significant reaches of salmon streams.

Stream Protection Flow Control

A broadly applied mechanism for mitigating changes to natural hydrology is the stream protection flow control standard. Much of the degradation of urban streams is related to increase erosive work performed on the natural channel from increased surface runoff volumes created by urban development. Two hydrologic factors can contribute to increased erosion rates and habitat degradation increased peak flows and increased time spent conveying high flows. Therefore, to protect against increases in the rate of erosive channel work, the “duration” of high flow discharges should be maintained at existing levels.

Conventional detention strategies only control peak flows in order to maintain the existing conveyance capacity of the downstream drainage system. Typically, with an increase in the amount of time these high flows are discharged. King County and others have been applying special stream/erosion protection standards since 1990 using an SCS based event model, such as the Santa

Barbara Unit Hydrograph (SBUH). Because the SBUH methodology uses a single design storm for analysis, it is impossible to determine changes in high flow durations over time. Therefore special release rates were developed from long-term historical simulations using the HSPF model. The most commonly used SBUH stream standards are the King County "Bear Creek" Standard and the Washington State Department of Ecology (WDOE) Standard, as described below.

Common SBUH Stream Protection Standards

R/D Facility Discharges		King County (Bear Creek Stnd.)	WDOE Puget Sound Stnd.
2-year	released at	50% 2-year pre-developed	50% 2-year pre-developed
10- year	released at	2-year pre-developed	10-year pre-developed
100- year	released at	10-year pre-developed	100-year pre-developed
Volume Safety Factor		30%	Varies (~30%)

Stream protection standards work by slowly releasing the increased runoff volumes at rates below what will cause increased channel erosion. The WDOE standard sets the minimum level of protection now required in much of Western Washington. However, comparisons of the two standards using historical simulations indicate that the more restrictive release rates (Bear Creek) better protect against increases in high flow durations. The Bear Creek standard has been shown to provide substantially complete mitigation of high flow durations for fully-forested land conversions, and is currently required in most resource stream basins in King County.

Performance of SBUH based stream standards is best with forested conversions and degrades for sites which are cleared or partially developed under pre-developed land use conditions. For this reason, King County requires in more sensitive drainage basins that the pre-developed site be assumed to be fully-forested regardless of actual conditions. Performance is also highly sensitive to off-site flows being routed through the facility. In conventional detention it is often desirable to route any off-site flows (upstream flows not from your development) through the detention facility, with the orifices upsized to pass the off-site contribution. This practice however causes significant degradation in performance for detention ponds sized using one of the calibrated stream standards. In addition to higher release rates, the storage volumes also become substantially reduced. For this reason, stream protection facilities should be placed off-line from significant off-site flows. Minor off-site sheetflow should either be detained to the same standard or ignored in the sizing of the facility.

Continuous Flow Models

Two hydrologic models are discussed, the US-EPA Hydrologic Simulation Program-Fortran (HSPF) model, and a simplified implementation of HSPF named the King County Runoff TimeSeries (KCRTS) program. The HSPF model was developed in 1980 based on the Stanford Watershed model, and has been used for Basin Planning and Master Drainage Plans in King County over the last decade. The KCRTS model has been developed for implementation of continuous flow modeling for use in design of stormwater facilities for urban development. Continuous flow models allow direct measurement of high-flow durations over a long period of time.

The stream protection standard for continuous models is more straightforward, control the duration of high-flow discharges to pre-developed levels, for all flows between 50% of the pre-developed 2-year and the pre-developed 50-year. The term "flow duration" is defined as the percent of time that a given flow rate is exceeded within the simulated continuous flow record. Flow durations are

normally calculated at 16 or more flow rates, encompassing the range of flows encountered, and graphed as duration of exceedence versus flow rate.

"Threshold of Concern" - The lower limit of the range of flow-control is the rate of flow above which increased erosion is expected to occur with increases in the amount of time the natural channel sees flows above this rate. This flow rate is sometimes called the channel formation flow rate. The threshold of concern can vary for different stream reaches and may be estimated through a tractive force analysis of the channel. However, it is most common to use 50% of the existing 2-year conditions to approximate the lower level of concern.

The HSPF model requires nearly 40 years of continuous hourly rainfall records and daily evaporation data. It is highly calibratable to specific basin conditions which also makes it very cumbersome to use. The US Geologic Service has developed "regional parameters" for use with the HSPF model for a range of soil and land cover conditions. The regional parameters were developed from gauged basins in King and Snohomish Counties but have wider application to other Puget Sound regions with similar glacial till and outwash soils.

Research work at the University of Washington determined the feasibility of selecting a sub-set of water years from a long-term historical record that have similar statistical characteristics. These shorter duration runoff files allow fast repetitive calculations, such as with detention sizing, that would be very time consuming using the full historical record. This work was used in developing a 8-year sub-set of water years that exhibit statistically similar flow frequency and flow durations characteristics when compared to the full historical period of record.

The new KCRTS model implements the runoff files methodology. Runoff files are pre-simulated unit-area runoff records generated from the HSPF model using regional parameters. Runoff files can be scaled and summed to generate a timeseries of continuous runoff representing different site assumptions. KCRTS supports hydrologic analysis using both reduced 8-year and full period-of-record, up to 99 years, runoff files.

Currently runoff files have been generated for 6 gauges in King County. The applicability of the regionalized parameters is believed to extend through much of the maritime Puget Sound region. King County will work with other agencies in the region to develop runoff files from local historical gauge data. This can be done incrementally by first creating historical runoff files, followed by verification of the regional parameters to local conditions, and finally generating and testing of reduced 8-year datasets for regulatory implementation.

Findings/Recommendations

- Development in sensitive stream basins is inevitable.
- As has been documented, non-controlled ("Effective") impervious results in significant degradation of stream resources.
- New impervious areas associated with development should be made "Non-Effective" through the appropriate level of flow control targeted to the downstream resource or drainage system.
- Detention required of new development in the region has historically only controlled peak flows and not the durations of high flow. As work is a measurement of Force over Time, the duration of high flows is very important in protecting against changes in stream morphology.
- Increased detention standards have not been widely applied in the region. In King County, implementation of stream protection standards has been done slowly using a basin by basin assessment.

- Discussions with County staff involved in developing the 1979 and 1990 Design Manuals indicate that if we knew then what we know now, we would have required stream protection flow control as the base standard. The Basin Plans would have identified areas where conventional detention would be adequate, or areas with special drainage concerns.
- Stream protection flow control can best be achieved by using a continuous hydrologic model, such as the HSPF or KCRTS computer models. However, calibrated release rates applied to SCS based event models (e.g. SBUH) can be used to achieve, substantially complete mitigation.
- The performance of SCS based stream standards is highly sensitive to assumptions made by the designer. In order of importance:
    1. Off-site areas collected and conveyed through the detention pond, result in serious degradation of facility performance and smaller storage volume. Off-site areas should be bypassed around the facility, or they should be detained to the same standard (using actual off-site land use for pre-developed and post-developed conditions).
    2. SCS based stream standards perform better for sites that have fully-forested pre-developed conditions. Performance degrades as the existing land-cover assumptions become more fully developed. For this reason, in more sensitive basins it is recommended that all sites be assumed to be fully-forested for determining allowable release rates.
- Continuous flow models can be cumbersome to use and require 30+ years (40+ preferred) of continuous precipitation and evaporation data to run. Continuous models can directly measure changes in flow durations and therefore can be used to efficiently and effectively provide mitigation protecting against changes in flow durations.
- The new KCRTS model, developed by King County, uses pre-simulated runoff files generated by HSPF. The KCRTS model is easy to use, since runoff characteristics from different land covers have been pre-calibrated to regional average conditions as published by the U.S.G.S. (Dinicola, 1992).
- Runoff Files for use in the KCRTS can be developed for local precipitation gauges which would increase the accuracy of the model over using the King County gauge data. King County is willing to assist others in generating runoff files for use in their locality. For more information contact Kelly R. Whiting at 206-296-8327.
- The historical performance of detention standards has not achieved the stated performance goals. This is due to limitations in the methodologies, and in the setting of detention standards which were not designed to achieve the desired performance objectives (e.g. stream basins with only conventional detention will see degradation).
- The SCS methodology was first applied in King County in 1990. Due to vesting and permit processes there have only been a few years of construction which have provided even this level of protection. It is not possible for anyone to say that detention is, or is not, achieving performance goals. Our decision to switch to the more accurate continuous model was supported primarily by Basin Planning efforts.

Discussion

Q: What is an example of the size of a pond required for stream protection?

A: For a forested conversion, it would be about 2.5 inches per gross acre of storage; for a pasture conversion, it would be about 2 inches of storage.

Q: What percentage of a typical development would the pond occupy?
A: It depends on the amount of foliage on the site and how deep you can make the pond.

Q: This morning, there were some critiques of how we are conducting flood control by Tom Holz. Any comments on King County's approach?
Comment (T.H.): Hydrologists often have differing opinions. I choose to differ with King County's approach. The notion of pre-development runoff is a false assumption.
A: SBUH was developed to size agricultural ditches - it has a nice, conservative peak flow built into the distribution for that purpose. It gives us a conservative design of our channels. When King County turned it around and made it into a detention model, those same elevated peak flows were used to determine the release rates. Release rates are definitely too high - we are overestimating release rates, especially for pasture conversions. Fully forested numbers are the only ones that come close. We have required detention since 1979. For 11 years we used the YEW method. In 1990, we switched to the Santa Barbara method, recognizing its limitations. The ponds were not constructed until 1992, so we have only been able to look at the ponds for 2-3 years. It is too early to rule out detention as a management tool.

Q: We are dealing with issues such as: how much volume do we actually need; where the ponds are in the watershed; and what is the downstream effect?
A: We do not require developers to determine the downstream effects. There is an incremental impact of all the ponds being at their peak discharge at the same time. But if you control high flow durations, you can control the overall effect on the stream.

URBAN STREAM PROTECTION: FROM BYLAWS TO PARTNERSHIPS

Julia Gardner - Dovetail Consulting, Vancouver, B.C.

ABSTRACT

This presentation is based on a report prepared by Dovetail Consulting, Inc. for the Fraser River Action Program (FRAP) of Fisheries and Oceans Canada: *Urban Stream Stewardship: From Bylaws to Partnerships - An Assessment of Mechanisms for the Protection of Aquatic and Riparian Resources in the Lower Mainland* (1996, 06, 07, Fraser River Action Plan Urban Initiatives Series). The purpose of this report was to synthesize current knowledge of the range of mechanisms for protecting urban aquatic and riparian resources and their effectiveness; identify issues and possible solutions to problems in the protection of urban streams; and recommend ways of overcoming key problems hindering the protection of urban streams.

The study focuses on experience in the watersheds of the east side of the Georgia Basin, examining management tools and methods for aquatic and riparian habitat protection that are primarily the responsibility of government, including planning, organizational and legal arrangements. It builds on the work of Partners in Protecting Aquatic and Riparian Resources, an informal coordinating process that was organized to engage federal and provincial agencies and local governments in a collaborative process to explore and reach agreement on improvements in the way we protect aquatic and riparian ecosystems at the local level. It also draws heavily on the results of another report produced for FRAP: *Protection of Aquatic and Riparian Habitat by Local Governments - An Inventory of measures adopted in the Lower Fraser Valley* (Quadra, 1995).

Fifteen mechanisms are examined as follows:

Mechanisms which are primarily within the jurisdiction of local government:

_ Municipal and Regional Planning
_ Municipal Organizational Arrangements
_ Zoning Bylaws
_ Environmental Protection Bylaws
_ Municipal Approvals and Management of the Development Process
_ Environmentally Significant Area Identification and Designation
_ Greenways and Parks

Mechanisms that involve local governments and senior government agencies:

_ Monitoring and Enforcement
_ Coordination between Governments and Agencies
_ Senior Government Environmental Approvals: The “Referrals” Process
_ Technical Guidance for Local Government and the *Land Development Guidelines*
_ Information Collection, Management and Exchange

Mechanisms involving the community and the private sector:

_ Protection of Private Land
_ Public, Developer and Landowner Awareness-Raising
_ Community and Conservation Organization Involvement

The mechanisms vary widely in their effectiveness. Examples of effective or at least promising tools are development permit areas and the identification of environmentally sensitive areas. Monitoring and enforcement are perhaps the Achilles heel of the current system of protective mechanisms,

while public, developer and landowner awareness-raising and involvement have much potential. The referrals process is a continuing source of frustration, though measures such as Environmental Review Committees are helping to alleviate inefficiency and inconsistency. Technical guidance for local government is essential if responsibilities for stream protection are to be increased at the local level.

Four over-riding issues cut across the various types of mechanisms, all of which have both real and perceived components: costs and local government capacity; liability concerns of local government; "downloading" by senior agencies, and "lack of political will" at the local level; and limits on the environmental jurisdiction of local governments. Selected aspects of these issues are discussed briefly below.

Perceptions of "downloading" stem from actions over recent years by the federal Department of Fisheries and Oceans and the provincial Ministry of Environment, Lands and Parks to promote the increase of responsibility at the local government level for the protection of aquatic and riparian resources. At least four possible reasons for these actions have been put forward by various observers:

1. Land use and management of development is a local government purview and senior agencies have limited authority to influence it.
2. Local governments' familiarity with their land/water base and their responsibilities for site level management mean that they are in a better position to care for the resources “on their doorstep.”
3. Fiscal and staffing constraints on senior agencies mean that they do not have the capacity to carry out the detailed regulation of activities impacting on streams at the local level.
4. Some speculate that senior agencies may wish to reduce their involvement in decisions regarding restrictions on the use of property such as the establishment of buffer zone widths, thus reducing the accompanying political burden.

Senior agencies have taken significant measures to support the increase of responsibilities at the local level, including the provision of technical support and the contribution of 50% funding for municipal staff positions focused on urban stream habitat. Such actions decrease the legitimacy of accusations of downloading.

Explanations of why local governments are not eager to catch the baton of environmental protection that is being passed to them - "lack of political will" - include:

1. As for senior agencies, fiscal and staffing constraints are a major concern. Locally, these are exacerbated by constraints on expertise, and by a broader range of priorities competing for attention.
2. At the local level property owners and developers have closer access to government decision-makers and can therefore apply pressure against constraints on land use intensely and with some financial leverage. As in point 4, above, some speculate that local governments wish to avoid the “bad guy” image associated with placing restrictions on property use.
3. Some municipal councils believe that their electorate has not granted them a strong mandate for environmental protection in relation to other policy and fiscal priorities. (Some councils have "greener" tendencies than others, with varying correlations to constituency priorities.)
4. Local governments have concerns about liability. They feel they cannot afford the costs of defending environmental protection measures when taken to court by protesting landowners; they see a risk of prosecution by senior agencies if they do not adequately enforce stringent protective measures; and they identify city ownership of leave strips, etc. with liability for public safety (and risks to bordering properties).
5. There is a perception of a lack of legal authority to implement environmental protection measures at the local level. Many observers within and outside local government have called

for strengthening of environmental provisions in the *Municipal Act*, while others believe that the Act is currently powerful enough.

Solutions to these problems rest in three categories of mechanisms for the protection of aquatic and riparian resources: regulatory, economic and voluntary mechanisms. In the Lower Mainland considerable emphasis has historically been placed on *regulatory mechanisms*: legislation, regulations, bylaws, approvals, monitoring and enforcement. The success of these mechanisms has been limited. Actions should be taken to improve the mechanisms that have promise but are not working to their potential. Selected regulatory mechanisms should be strengthened and/or augmented. Landowner/developer backlash against perceived "over-regulation" needs to be taken into account, especially for its potential to increase resistance to the voluntary mechanisms.

Economic mechanisms have received relatively little attention. These are tools such as taxes, subsidies, property rights and charges. Given the strong role of the development community, and the high level of concern about costs to local government, these tools deserve further exploration, and some new mechanisms should probably be developed and tested. For example, a study of full cost accounting for the protection of aquatic and riparian resources, involving all levels of government and other players, could be illuminating.

Voluntary mechanisms such as community stewardship show strong promise for the protection of aquatic and riparian resources. They have an immediate impact in the form of prevention or restoration of degradation through surveillance and rehabilitation work, and a series of secondary benefits including education, awareness-raising and the building of a constituency to promote political change towards environmental priorities. These benefits considerably reduce reliance on regulatory mechanisms, taking the pressure off costs of enforcement and concerns about liability. Encouragement of voluntary actions on the part of landowners and communities therefore deserves ongoing and increased support.

In short, there needs to be a balance among the three types of mechanisms: pursue the promise of voluntary approaches, research and implement economic incentives, and continue to improve regulatory instruments. All three areas can benefit from partnerships among the different levels of government, community organizations and landowners and developers.

Discussion

Q: Economic mechanisms are a grey area for governments to deal with because there are no guidelines. We need to have acceptable criteria.
A: Yes, the more grey for government, the more acceptable and flexible for landowners and developers. It is a balancing act between managing flexibility and maintaining accountability to the public.
Comment: We have to base criteria on defensible, scientific criteria.

Q: (J.G.) Are there any tools that exist that do not fit into the three categories of law, information/education and economic?

Q: What about policies and guidelines without a law base, where there is no jurisdiction.
A: You have to depend on one of the three. e.g. persuasive techniques - information and education - not just by government, but by the community also. The community plays a big part in building support for protection.

Q: What about planning tools? Are they viewed as information or regulation?
A: It depends on how you implement your plan - an OCP is law, but it is not implemented until there are bylaws. When you actually hit the ground, you are using one of the three mechanisms.

Q: In light of the startling results of the urban audit report, these three mechanisms need to be looked at closely. We need to figure out how to stop that (non-compliance) from happening. Who is going to monitor and do compliance? So we have to develop information and communication processes in a cooperative manner.
A: That is where partnerships come in - not just between government agencies, with the community - but it will be difficult in light of the "tax revolt" attitude that is going on. If people had more tools in the economic category, we would all be better off. However, we like to think that full cost accounting will protect the environment, but it depends on the scale of decision making.
Comment: Landowners like to have a friendly face in government to get technical guidance. The problem is that they hold you to what you tell them in an informal manner, as information. And it becomes the law.

Comment: There is a role for stewardship groups - they have the technical information and local knowledge. They are a good source of information.

Q: How do you define stewardship?
A: Stewardship often means ways of protecting the environment. A narrower definition often means volunteer stewardship. This is occurring mainly at the watershed level in B.C. right now. Municipal employees do not have enough evenings in the week to attend all the meetings and sit on committees with stewardship groups.

Q: How do intergovernmental partnerships fit in to this thought process?
A: Partnerships can streamline implementation of the laws. The referrals process could be smoother. Environmental partnerships should make the laws less costly (in terms of delays, etc.). Coordination kick-starts information and awareness raising. We asked municipalities - "What if you had the information about where all your environmentally sensitive areas are?". Some saw that kind of information as pivotal. Others say that the other barriers re: politics and economics are overwhelming compared to our need for information. Information has to be coordinated. It is difficult for municipal governments to use information coming from all different sources. Agencies have been working on this.

Q: Can we use design techniques to access the economic component?
A: Part of what I was asked to look into was: do we need to reactivate PPARR? Perhaps, but maybe Environmental Review Committees are filling that role, and not if it takes more time than it is worth.

SESSION 3: RESTORATION

Chair: Glen Carlson, B.C. Ministry of Environment, Lands and Parks

CAN FISH HABITAT BE ENGINEERED?

Jim Bomford - B.C. Ministry of Environment, Lands and Parks

STREAM RESTORATION - GOOD SCIENCE OR POLITICAL EXPEDIENCY?

Mike Miles - M. Miles and Associates

BLACK LAKE MEADOWS WETLAND RESTORATION, LANDSCAPE TRIAGE, OR JUST GOOD KARMA?

Andy Haub - City of Olympia

SALMON RIVER WATERSHED - THE LANGLEY EXPERIENCE

Pete Scales - Township of Langley

HABITAT PROTECTION AND RESTORATION EXPERIENCES IN URBANIZING KING COUNTY

Gino Lucchetti - King County Department of Natural Resources

RESTORATION IN THE LOWER MAINLAND

Matt Foy - Resource Restoration Division, Fisheries and Oceans Canada

PANEL DISCUSSION

CAN FISH HABITAT BE ENGINEERED?

Jim Bomford - Fisheries Branch, B.C. Ministry of Environment, Lands and Parks, Victoria, B.C.

ABSTRACT

Human interference into the workings of natural biological and physical processes is ubiquitous and often leads to their dysfunction. The genesis of this dysfunction is frequently in the solutions engineers are asked to apply to society's infrastructure problems. The effects of this engineering interference are particularly evident in aquatic ecosystems in urban areas. Many people accept the inevitability of such progress driven perturbations, tending to believe we are able to mitigate them if we just apply technology appropriately - if we engineered our way into this situation then surely we can engineer our way out of it. This is a mistake. Natural processes such as the ecological systems and mobile-bed stream systems which, working together in fluvial settings, create salmonid habitat are, by definition, self-organizing. And self-organizing systems do not pay a lot of attention to what it is, we as engineers, want them to do. Trying to design them is like trying to herd cats; unless you have got them all in a box, it simply doesn't matter how you want them to behave, they won't. What engineers can do to foster recovery of freshwater ecosystems, both in urban settings and elsewhere, is to work toward protecting or establishing those system conditions (watershed hydrology and riparian habitat) most likely to produce the desired system behaviour (the pattern and structure we call fish habitat). In most situations engineered fish habitat is a blind ally leading to unrealistic expectations of increased productivity.

Introduction

In 1993, the Ministry of Environment retained fluvial-geomorphologist Mike Miles and biologist Gordon Hartman to undertake a study to evaluate factors affecting the success of provincial fish habitat improvement initiatives. The study was commissioned as a result of failures in such initiatives that biologist Ron Ptolemy and I had experienced or witnessed during our tenure with the Ministry. When we began this exercise we did so naively thinking that it was important to know how we were doing so we could improve the performance of our works. Little did we realize at the time that we were opening a Pandora's box which would expose a somewhat unsettling reality. The results of the study indicated that our successes were both few and short lived. I think it would be safe to summarize the results of the evaluation by saying that, biological productivity aside, the key factors dictating structural stability of habitat improvement works was not necessarily the design of habitat features, it was the stability of watershed processes. And, while the study did not focus specifically on urban streams, its findings are certainly applicable to them.

The concept of urban salmon habitat has a certain emotional appeal. It brings to mind visions of warm fall days in parks with children running to the edge of babbling brooks to witness the primal experience of salmon returning to spawn, like swallows returning to Capistrano. The reality of urban streams, however, is a little more sobering. Urban streams, for the most part, do not exist. What were fish bearing streams prior to urban settlement are now storm sewers and what are at present fish bearing streams in future settlement areas may soon exhibit classic symptoms of storm sewer morphology. This morphing of streams into storm sewers is, without exception, due to human activity in watersheds.

Human Interference in Natural Processes

Human settlement as we have come to know it could almost be defined as the practice of interfering in natural processes in order to solve environmentally induced problems, and engineers have traditionally been the ones called upon by our society to find solutions to these problems. However, it is only recently that the engineering profession has been asked to expand its horizon to include the interests of non-human animals like fish. In trying to deal with the competing interests of humans and fish at the same time, engineers almost invariably find themselves in the unsettling position of not knowing what fish, as clients, expect of them since they don't complain about oversights in our designs, they just quietly disappear. To make matters worse, the techniques engineers have developed over the years to deal with problems of human habitation are, as a rule, not applicable to the problems of fish habitat. Our engineering is, as often as not, the cause of habitat dysfunction as it is the cure.

If fish could talk and we asked them, "Which of our engineering techniques have had the most negative impact on fish habitat?", my guess is that the answer would be paving. Paving, in its broadest sense, means covering with hard material in order to smooth or firm a surface. Paving is the primary tool employed by civil engineers in the development of urban infrastructure; it includes the smooth, firm, surfaces we know as roofs, roadways, sidewalks, lawns, pipes, ditches, culverts, curbs, catch basins, canals, revetments, and the like. (Some people might say these are distinct technologies because they look different and we use different mathematical formulas to determine the behaviour of water under their influence; I would argue that all a canal is, is paving bent in a u-shape, and all a pipe is, is pavement rolled into a cylinder.) Paving is a wonderful device from an engineer's perspective, its beauty being its simplicity, efficiency, and predictability. It eliminates the messy uncertainty associated with natural processes and controls them in our human interest.

Paving is also what separates the technical discipline of hydraulic engineering from that of fluvial-geomorphology. Hydraulic engineering is primarily concerned with rigid boundary hydraulics (controlled processes), while fluvial-geomorphology is concerned with mobile bed hydraulics (self-organizing processes).

Paving is anathema to fish; interfering with the dynamic interaction of hydrological, ecological and geological watershed processes that create and maintain, or destroy, fish habitat. Changes in habitat features within streams are dictated by changes to any one of these processes, and paving can interfere with them all. These paving induced changes, like the well publicized watershed changes due to forest practices, can manifest themselves as habitat limitations such as: too little large woody debris, too little cover, too little spawning gravel, too few holding pools, too low water, too high water, too slow water, too fast water, too warm water, or too dirty water etc. However, the impact urban development has on fish habitat makes forest practice impacts pale in comparison.

In urban settings paving is ubiquitous and it is the cumulative result of years of good engineering practice. Without paving urban settlements could not exist; with it fish habitat has trouble existing.

We Engineered Our Way In, Can We Engineer Our Way Out?

Our society is now making an attempt to change the way we do business with nature. However, to date our attempts at ecosystem protection and restoration have concentrated on the revision of means rather than ends - trying to change how we do things rather than the things we do. The fact that virtually none of our efforts at changing how we do things has made much difference to the rate of habitat loss is indicative of a problem of limits, not technique. It is not a simple mater of applying the appropriate mitigation or restoration technology to a particular habitat problem. In fact, given what we know today about the success of our technical fixes, it is not about technology at all; it is about limits to the appropriation of natural resources. An example of these limits to coexistence is

evident in the work of Richard Horner and his associates from Washington State. Their correlation of the total impervious area of a watershed to a stream's productivity in indicative of both limits and thresholds. Either we allocate watershed resources to fish, or we allocate them to humans - we can't have it both ways. Practical people - engineers, biologists, planners, developers and the like - when faced with this kind of rhetoric are inclined to say, "So what, we've heard all of that before. The question is how do we progress from here? Growth is inevitable, and we have got to accommodate it. And, whether we like it or not, we have laws that tie our hands when it comes to managing public interest on private land and private interest on public land." I do not have an answer to this conundrum other than to say that there are physical laws governing natural, self-organizing, systems that cannot be shoe-horned into common law and expected to work. Physical laws control physical processes, common law controls legal processes. And processes such as the ecological systems and mobile-bed stream systems which, working together in fluvial settings, create salmon habitat are, by definition, self-organizing. Ever since technology has given us the tools to modify them in our self interest, our society has sacrificed self-organizing natural environments in the name of progress and private property rights. The resulting losses in habitat have consistently been rationalized by assumptions that environmental impacts are picayune and ephemeral. Human interference may be situationally small, but it is not ephemeral; it is cumulative and in our urban settlements it is long term.

This is not to say that engineers cannot design functional ecosystems; they can, but to do so they have to do it in a box, where they can control inputs and outputs of material and energy; examples of such systems are sewage treatment plants and fish hatcheries. But nature does not do well in a box. Habitat complexing can replicate habitat features in stream ecosystems, just as bird houses can replicate habitat features in avian ecosystems. However, there is no technical evidence that I am aware of that would justify the widely held belief that engineered habitat features can, in any sustainable way, compensate for impacts to watershed processes. Such habitats, in certain situations, may, with the addition of significant resources for operation and maintenance, provide temporary relief in streams under recovery but that is about the best we can hope for. There is no substitute for a naturalized hydrograph, a mature riparian corridor, and channel bed which is in dynamic equilibrium.

What Can Engineers Contribute to the Cause of Fish Habitat?

The most appropriate metaphor that I can think of to describe the situation engineers now face in attempting to restore some integrity to salmonid streams is that of Humpty Dumpty, ".....and all the King's horses and all the King's men couldn't put Humpty together again." Humpty was broken, plain and simple. And, just as no amount of "how to" drawings depicting what an egg looks like can provide us with the information necessary to build another egg, no amount of pictures describing what fish habitat looks like can help us to recreate actual habitat. The only thing that can be employed to create a functional egg are functional chickens and the only things that can be employed to create sustainable fish habitats are functional watershed processes.

Despite my belief that habitat recovery is not a technical issue, engineering obviously has a huge role to play in habitat protection and recovery. In particular it can help in retaining or regaining a semblance of natural, pre-development, watershed conditions. In most existing urban areas, watershed and stream recovery is an almost impossible task; the obstacles in the way of turning storm sewers into streams are virtually insurmountable. By all means we should work toward cleaning them and greening them - but call them what they are, don't call them salmon streams. In suburban areas where remnant habitats still exist, in spite of dysfunctional watershed processes, limits to further interference should be considered. In rural, agricultural and forestry areas it is still physically possible to foster watershed recovery and therefor habitat recovery. But only if legal, financial, and cultural hurdles can be overcome in reclaiming land for the purpose of restoring watershed processes.

Conclusion

Wherever land-use changes are contemplated, engineering can be employed to minimize the impact of our interference in natural watershed processes. But don't expect even the best engineering to fully mitigate the inevitable consequences of human settlement - habitat losses will occur. All the public is hearing now, however, is that we have the technology to restore habitat, we have the programs in place to apply this technology, and we are out there doing it. I believe this message is counterproductive; we must be prepared to advertise failure with as much energy as we put into advertising success. Habitat for wild fish is not an engineering problem and we should guard against shifting the burden of responsibility for its protection from its rightful place as a social issue to a technical one.

Discussion

Q: You showed a photo of Deer Park. Where is that?
A: Deer Park is in Mill Bay, just north of Victoria.

Q: How would you have developed that area differently?
A: I would not have allowed development on that property. The watershed is a community water supply and a watershed for a coho and cutthroat stream. That piece of property should not have been re-zoned for development. It is a fragile piece of habitat.

Q: Since the province has control over land use, what is the answer?
A: The province does not have control - the local government has the ultimate control.

Q: Then how do we, as a society, answer the problem?
A: We inject ourselves (bureaucrats) into the land use decision making process. Comments made by bureaucrats in the referral process never get heard by the public at large. We should stand up at public hearings, as government employees, and express our concerns.

Q: Are there many public groups that ask you to be involved in processes in such a way?
A: No, they generally do not trust us.

STREAM RESTORATION - GOOD SCIENCE OR POLITICAL EXPEDIENCY?

Mike Miles, M.Sc., P.Geo. - M. Miles & Associates, Victoria, B.C.

ABSTRACT

Society, government organizations and politicians appear to be becoming increasingly aware of how land use practices are altering stream channel processes and impacting the associated fisheries resources. Regulations and public attitudes have developed from requirements for mitigation or compensation to large programs whose stated objective is stream restoration. The employment opportunities for out of work loggers and fishermen, and the ability for community groups to participate in this work, undoubtedly adds to the popularity of these projects. It is nevertheless important that the success of these works be critically assessed, such that future efforts can be wisely directed.

A variety of studies have been recently undertaken to assess the performance of fisheries habitat enhancement projects. The results are summarized below:

AGENCY AND LOCATION	% PHYSICAL SUCCESS RATE	REFERENCE
Alberta Fish and Game, SW Alberta	19	1, 2, 3, 4, 5, 6
Oregon and Washington	40	7, 8
Alaska	44	9, 10
Alberta Oldman River Dam Project, SW Alberta	49	6
B.C. Ministry of Environment	55	11, 12, 13
US National Forests	80	14, 15

With the exception of work in the US National Forests, the reported physical success rates are discouragingly low, particularly when it is realized that the post-construction assessment period is typically on the order of 2 to 6 years. Biological success was not commonly evaluated. Most biological assessments were undertaken principally on the basis of physical stability. The US National Forest projects have anomalously high physical success rates. This is thought to reflect both an annual maintenance program and the methodology used to define success.

The above results indicate, at the least, that better criteria for locating, designing and constructing instream structures are required. A provision for on-going maintenance is also necessary, as are better monitoring programs to determine biological success and improve the basis for future design. However, the principal lesson is that structural measures to provide fisheries habitat do not persist, particularly in higher energy alluvial channels. This conclusion is not surprising, given that fisheries habitat in un-impacted channels is routinely created and destroyed. The primary objective of stream restoration projects should therefore be to restore the processes which are responsible for habitat development, rather than to artificially create structures which are frequently ephemeral. This is much more difficult than placing woody debris and boulders in the channel or excavating off-channel habitat areas. It requires evaluating, and possibly modifying, land use practices throughout the

watershed. It means dealing with water quality and quantity issues. Ideally, it requires the preservation or restoration of valley flat and riparian areas and educating the population as to ecological and practical benefits of maintaining a corridor through which a stream can freely migrate. These tasks are formidable given the large areas over which they need to be undertaken. Such work requires competent technical expertise, landowner cooperation and political will. However, the compilation of regional success statistics indicate that, if stream process is not restored and maintained, stream restoration projects will frequently have little or no long term benefit.

Discussion

Q: Did you use the limiting factors as clues? Often we just re-make a structure, rather than saying, "what is responsible"?
A: Gord Hartman was our fisheries biologist - his point was that we need to look at the factors in the environment that limit the production of fish. Winter habitat is important. But it is difficult to determine what the limiting factors are. In many cases, people don't know what the limiting factors are, so they will set an objective to provide catchable sized trout - i.e. you need 1 m water depth - but what do we need to support the trout's food sources?

Comment: We need to understand the role of the structure in the process.
A: It is difficult to do biological work. So we get historical air photos and compare what the stream used to look like with how it looks now. Usually the problem is a lack of vegetation.

Q: Your Craigflower project had some robust features. I was trying to get a feel for the power of the stream.
A: It is a low energy creek - it's 7 m width decreases to 2-3 m by urban encroachment. So we built as robustly as we could, so that the undercut structures could last 50-100 or 200 years.

Q: Re: limiting factors - are you familiar with developing protocol for limiting factors? You establish the statistical basis for analyzing what is going on in a basin. Using physical factors, you can determine what is missing (e.g. spawning gravel). This gives us a context for our restoration projects (in Snohomish County).
A: That makes sense. It was estimated that the Coquihalla River could handle approximately 2,000 steelhead. During our study, we had 20 and 40 steelhead. Last summer, they changed the fishing regulations and we had 800 steelhead return. Simply changing the fishing pressure in the Lower Fraser dramatically increased the numbers getting back.

Q: Were you able to go into your database and figure out why the structures failed?
A: It was to be a four phase project. Phase Two was to go out and do assessment. Phase Three was to be a failure analysis. After the Phase One report, the Watershed Restoration Program began. The results were extremely unpopular. The report did not go anywhere because it was not politically accepted. In Alberta, we looked at 275 projects, we looked at what hydraulic factors affect performance and what fluvial factors affected performance. This was done retroactively, not with the correct database. The only hydraulic parameter that seemed to make any sense was a single boulder tended to remain in place if it was 25 times bigger than the average size. From a fluvial geomorphology perspective, structures tended to work better in channels with a single thread, laterally stable, and banks more than 2.5 m high, and retaining small amounts of bed load.

Q: Can you expand studies regarding the relationship the stream needs to maintain its process?

A: If we can maintain half the stream channel width in vegetation, we will get about half the amount of erosion if there is no bank vegetation. If you maintain more than half the rate, the erosion occurs at a fraction of the rate of a bank with no vegetation. We actually need a band approximately seven times the average channel width. When this is proposed to ranchers, they are not impressed. If you are in a stream channel that is very unstable, you might need to make it 14 times the amount of vegetation. If you want to give it a corridor by which the river can migrate, get old air photos and see what it has been doing over the years.

Q: Streams have had vegetation removed. We can say "put back the riparian vegetation", but what is the time frame for recovery?
A: In the U.S., they have done that, and in 20 years they appear to be recovered. In Alberta, it has taken between 10-20 years in some small streams. At Jones Creek, there was natural re-establishment of coniferous trees in an area which had been logged to the stream bank; it has recovered over a period of 30-40 years.

BLACK LAKE MEADOWS WETLAND RESTORATION, LANDSCAPE TRIAGE, OR JUST GOOD KARMA ?

Andy Haub - City of Olympia, Olympia, WA

ABSTRACT

In 1992, the City of Olympia implemented an aggressive funding program aimed at improving local instream habitat conditions. In the following four years, the community has spent well over $3,000,000 of the City stormwater utility rates on the habitat enhancement projects. Completed projects include the re-route of a major creek and several fish ladders to allow salmon passage, instream enhancements, and numerous revegetation efforts. While the projects are community successes that reflect our commitment to the local environment and future generations, the biological benefits provided by the projects are minimal.

Given these limited successes, we have focused our habitat management efforts on understanding and providing the necessary level of effort to accomplish a single biologically-viable habitat enhancement. We chose the 45-acre Black Lake Meadows site as the test of our commitment. The site includes a productive salmon-bearing creek segment; an extensive, drained peat wetland; and partially logged uplands. Habitat enhancements have necessarily been part of, but are not overwhelmed by, the storage of 40 acre-feet of treated stormwater on portions of the site. With appreciable attention to design, construction, and revegetation details, the project represents our best local attempt at achieving meaningful habitat enhancements.

Two years after construction, the hydrology of the peat wetland is capable of supporting viable biological communities. Subsequent revegetation work and invasive species management has involved several years of study, approximately 17,000 plantings encompassing 50 species and the commitment of many individuals. Even so, the vegetation dynamics of the site present a large-scale battle between beneficial forces and problematic ones. Ongoing management of the site resolves around foreseeing vegetation responses to site hydrology and very promptly responding to potential problems. Fortunately, our responses have been quick and adequately funded. So far, we have met, and in some important ways, exceeded, our biological expectations for the site. However, we know that we must rigorously monitor and maintain the site or lose the battle for habitat improvements. The question must then be asked: are we truly achieving wetland restoration, practicing landscape triage, or just accumulating some good karma?

Speaking Notes:

Is Black Lake Meadows the right project?

- Factors in Our Favor:
  - Geology and soils
  - Water quality
  - Biological connectedness
  - Physical traits of the site
  - Money
- Factors against us:
  - Groundwater
  - Vegetation
  - Long-term commitment?

What does successful habitat enhancement require?

- Day-to-day management:
  - What level of day-to-day site management is necessary?
  - How can we accomplish the work?
  - How much does it cost?
  - Will community organizations help?
- Long-term management:
  - Can energy and commitment be maintained year after year?
  - What does long-term commitment imply? By who?
  - Can we accomplish our goals? Multiple goals?
  - Is habitat enhancement a feasible management technique?

Revegetation planning...look and look again

- Numerous pilot studies
  - onsite plant salvage and replant prior to construction
  - willow staking at various hydrologic regimes
  - sedges here and there
  - exposed upland area with irrigation
- What did we say we were going to do?
  - unpermitted living plants are better than dead permitted plants
- Youth at risk revegetation contract
  - install 17,000 plants, 50 species
  - professional oversite

Invasive species must die...

- Scot's broom
- Reed canary grass
- Blackberry
- Begger's tick

Approximately 250 hours of professional and volunteer labor just last summer

Irrigation...there's no choice

- Use of creek withdrawals, so far
- per surviving plant with 26-65% survival rates for last summer -dedicated staff
- This summer...7,500 feet of line, 400 sprinkler heads, big pumps?

So far, it's doing ok...

- Good site characteristics. Simple design.
- Ample budgets...maintenance funds provided by capital budget.
- Frequent onsite presence...observation of hydrology, vegetation, wildlife, vandalism.
- Fast response time...often the next day.
- Evolving goals with new players and energy. One enhancement site at a time.
- Lots of volunteers.

Five more years to go?? Ten more years??

Black Lake Meadows...

Wetland restoration, landscape triage, or just good karma?

Discussion

Q: Did you identify your stormwater management pond as fish habitat?

A: Yes, but the storage areas for stormwater are not within the ditch. It is segregated.

Q: In your maintenance regime, will there be a need for detention when build-out occurs?
A: We would still require stormwater ponds in new developments upstream. There are, in fact about 70 acre feet of storage and many treatment facilities upstream. This project does not facilitate development - it is more of a "historical sin" type of project.

Q: What are the capital and maintenance costs of such a facility? Did you do any analysis on what is really needed for live storage?
A: The capital cost was about $1.8 million. About half of that was in acquiring property. We need a lot more storage to adequately mitigate the flows. This is the only site in the basin for stormwater management on a large scale.

Q: Have you thought of doing plant successions, rather than doing a bunch all at once?
A: This is new to us, so no, we have not attempted that.

Q: Have you done any water quality work, since this site is surrounded by an industrial area?
A: We are lucky. It was a state and federal concern of putting contaminated stormwater in a natural wetland. We have a lot of treatment and storage upstream and on-site, so we have good water quality at the site. We have not had a problem in 7 years.

Q: Why did the City of Olympia do this?
A: We have a stormwater utility. An environmental tax generates $2.5 million per year. About 1 million of that is used for projects like this. This was also part of the Basin Plan.

SALMON RIVER WATERSHED - THE LANGLEY EXPERIENCE

Pete Scales - Township of Langley, Langley, B.C.

ABSTRACT

History

The Salmon River Watershed, located in the Township of Langley, has a rich history of trade, culture and fisheries resources. The watershed takes up over 1/4 of the land surface of the municipality which is one of the largest in Canada.

Langley is a rapidly developing community and as a consequence many of the rivers and wetlands are facing unprecedented development pressures. The Salmon River, one of the last near pristine salmon producing streams in the lower mainland, was identified by senior government agencies as a watershed requiring protection against further degradation.

In 1993, DFO (FRAP) and the Township of Langley joined with several other agencies to develop a management plan for the watershed. Established as the Salmon River Watershed Management Partnership, partners included MOELP, MAFF, Langley, UBC Institute of Environment and Resources, B.C. Ministry of Health, FBMP, Langley Environmental Partners Society (LEPS), and other community organizations.

The Township of Langley recognizes the value of partnerships and of sharing human and monetary resources joined with Kwantlen University College to form LEPS. Membership of LEPS included DFO (FRAP), the Nicomekl Enhancement Society, Salmon River Enhancement Society, Bertrand Creek Enhancement Sub-Committee, the Yorkson Creek group and the Langley Field Naturalists Society. LEPS was set up to provide four major goals. These included being a major provider of public information on environmental issues (and in particular, stream protection); providing an umbrella-like co-ordination service for other environmental groups, to provide work related training; and conducting important instream restoration work involving volunteer work.

Utilizing the services of LEPS to organize volunteer work, the Salmon River Watershed Management Partnership was able to stick to its primary focus of establishing a workable watershed management plan. Each group possesses particular areas of expertise and tend to concentrated on them, coming together only when required.

The manner in which LEPS does business has been modified to the point that it now has a watershed focus as opposed to a community focus. Utilizing the best features of organizations such as FRAP and USHP, LEPS now provides watershed planning by assigning four watershed co-ordinators to work with community groups in particular watersheds. The result is a number of projects in each watershed that community groups have helped to plan and implement, using an experienced LEPS supervisor.

In the Salmon River Watershed, projects conducted since 1993 are primarily demonstration in nature. They include agricultural stewardship, anchoring and stabilizing of heavy woody debris, tree planting throughout the watershed and construction of the Williams Park information kiosk on watershed stewardship. Likely the most important co-operative future project on the watershed will be the upgrading of the pump station at the mouth of the river, a facility long known to be a fish grinder.

What Worked

1. Both SRWMP and LEPS are co-ordinated by a senior manager from the Township of Langley. This individual, partially funded by FRAP, is seconded for up to 90% of his time with community groups to co-ordinate environmental efforts within the community. He is afforded a significant decision making role, ready access to Council, administration, the public and regulatory agencies, and independence from bureaucracies.

2. Both LEPS and SRWMP use up-front success stories, habitat restoration and public education projects that maintain the motivation of volunteers and agency staff.

3. From the beginning, both groups sought technical and realistic credibility while remaining apolitical. As a consequence, Council, Township administration, senior government and the public support the work. This is not to say, however, that the groups involved in the umbrella service provided by LEPS cannot utilize political action to reach their goals. It means that it has been found to be more prudent to gain credibility first.

4. Likely the most important feature of both groups is the belief in the value of citizen and volunteer participation in a number of tasks normally associated with regulatory agencies.

What Didn't Work

1. In the case of SRWMP, expectations of having citizen groups to take ownership of the organization was misdirected. Often, citizens requesting more say in some aspect of the watershed management do not have the required technical background. Only after proper training and evaluation of expectation of tasks can citizens take a stronger role in strategic aspects of the management role and in particular, enforcement, data and land ownership issues.

2. A major area of concern was the positioning of volunteer groups with either the DFO/SEP way of doing projects, or how MOELP field staff preferred to have instream work conducted. Siding with one side or the other often led to friction. Both referral agencies have a long way to go to facilitate applications by community groups.

Discussion

Q: How did you get over the municipal engineers' fear of liability on your project?
A: Ministry of Environment also had a fear! We had the approval of the Township; however, on some projects, there may be little things that they may not agree with. The engineers are getting more "green", but it is taking time.

Q: Do you get any help from the Township for staff, equipment, etc.?
A: Yes, the Township provides money, technical assistance, and engineering assistance. Engineers come to the site and generally, they go along with whatever we propose.

Q: Do you include engineering drawings in your proposals?
A: No, these projects are generally citizen-run. A consultant, the municipality and DFO check our proposals to see if they will work.

Q: I agree that 50% success is better than 50% failure - it is a learning experience. But what about long term monitoring of the projects you have completed?
A: We have the benefit of using students from Kwantlen College and UBC for a long term monitoring program. All works are checked, often in the form of student theses or reports.

Q: The Salmon River is one of the more studied streams in the Province. Are there any more recent counts of coho, and trout smolts that are leaving the system?
A: We have noticed a steady decline from 10,000 returning adults to 1,500 last year. Habitat is a big reason for the decline, but overfishing is also a big factor. It is not demonstrated yet that there is a dramatic decline in output. There is a coastwide decline in escapement and spawn count by a factor of 10.

HABITAT PROTECTION AND RESTORATION EXPERIENCES IN URBANIZING KING COUNTY

Gino Lucchetti - King County, Department of Natural Resources, Seattle, WA

ABSTRACT

As part of a comprehensive approach to surface water management, the Metropolitan government of King County, WA, has implemented several programs to protect and restore salmon habitat and to reduce management costs. Comprehensive basin planning (e.g. The Lower Cedar, Bear, and Issaquah Basin Plans), regional needs assessments (e.g. Waterways 2000), and formation of regional forums of local governments form the basis of the planning, analytical, and intergovernmental efforts. Within and across basin priorities for habitat protection and restoration are identified and prioritized through interdisciplinary and multi-agency plans. Habitat protection through land purchase, acquisition of conservation easements, and regulations form the basis for salmon protection and is the County's highest priority because it is less expensive to protect than to restore, the success and cost effectiveness of restoration is still uncertain, and in many cases urban development precludes many restoration opportunities. Where restoration is pursued, the focus in order of priority is to: 1) reduce hydrologic and water quality impacts through actions ranging from stormwater ponds and bioswales, to retention or restoration of forest cover, to floodplain buyout; 2) restore connectivity among habitats by construction of fish ladders over artificial barriers and construction of groundwater fed side channels and ponds where loss of floodplain interactions has occurred; and 3) restore structural complexity to natural levels within a habitat (i.e. a stream reach) by riparian revegetation, especially establishment of coniferous based forest, and addition of very large, unanchored woody debris and debris/boulder complexes. A summary of King County expenditures by habitat type and objective and an overview of the Cedar River habitat restoration opportunities using the above principles will be provided.

Discussion

Q: Did you mention that you are using both a mandatory and a voluntary approach for forest cover requirements in new developments?
A: We had to give up our concern in the Cedar River over mandatory forest cover. The language of the basin plan was that there were mandatory open space requirements. Anything mandatory was not well-accepted. People said - we do not want to cut our trees down, let us do it voluntarily. So it is a regulated requirement in some watersheds, and in others, it is not. It is essentially a pilot study to see how well each approach works.

Q: Was it part of the State or the County regulations?
A: It was part of the Cedar River Basin Plan, so it is a site-specific regulation.

RESTORATION IN THE LOWER MAINLAND

Matt Foy - Resource Restoration Division, Fisheries and Oceans Canada, Vancouver, B.C.

ABSTRACT

Restoration of salmon stocks is a primary goal of the Salmonid Enhancement Program of DFO. The Resource Restoration Division delivers the habitat improvement components of the SEP program and supports community led initiatives to improve local salmon stocks. Common techniques DFO uses to restore salmon populations in human impacted watersheds include:

- fish culture techniques and hatcheries for re-establishing salmon populations in watersheds where they occurred historically;
- removal or passage around manmade barriers to allow anadromous salmon access to historic habitats;
- improving water flows to streams affected by water diversions or storage;
- modifying existing fish habitat to improve conditions for salmon; and
- creating fish habitats where none existed before.

Projects are generally:

- targeted at discrete species specific populations of salmon;
- based on analysis of limiting factors to salmon population productivity to identify appropriate restoration strategies;
- do not fundamentally change habitat conditions within watersheds, only components believed to control or limit salmon populations;
- assume improving or status quo conditions within watersheds;
- rely on strong protection measures to maintain existing fish habitat and overall environmental health within the watersheds;
- measured for success by the response of targeted fish populations to actions taken;
- require a reasonable economic return on investment unless there are overriding conservation or social concerns; and
- are generally done in partnership with other agencies and public groups.

Discussion

Q: Why do DFO projects have a high rate of success relative to others?
A: In the Lower Mainland, the primary target fish are coho and late spawning chum. They are outside of the active stem, in side channels. Coastal streams are such high energy, unstable environments. We have lost those environments. We are trying to do a little for a few species.

Q: Recognizing that retaining wild habitat creates less work and problems in the long run - what is DFO or MELP doing to preserve the last wild areas from development?
A: The problem is that the Federal government agencies have no say over land use - only if it harms fish. We have to let it be built and then deal with the damage - our legislation is reactive. We have to prove there is damage before we can do anything. It is the same issue with riparian strips. It is difficult to convince a lay judge that a 25 m leave strip is essential for fish. DFO looks after fish and fish habitat, the province looks after land and water, and the responsibility for land is delegated to municipalities in settlement areas. It is the land and water that make the habitat. There is a real need to bring local governments on side with agencies.

Q: When we had a good wetland in the United Blvd. area on the Fraser River - no one did anything to preserve it, then it was developed - we lost the majority of the wetland. So, when you know a pristine area is going to be developed, what can one do to prepare?
A: If the wetland is fish habitat and someone is going to build in it, we can do something, using the Fisheries Act. It depends on the will of the people involved.

PANEL DISCUSSION

G. Carlson: I sense that the message is one of caution - things are not working, so we have to be careful. Do not be too optimistic such that you are throwing a lot of money away on projects that are not likely to be successful.

G. Lucchetti: People are people, and are going to spend money on something. A lot of money gets spent on projects that are heavily engineered and heavily artificial. We have to shift the priorities so that money is spent on environmentally better projects. In the Puget Sound lowlands, there are lower energy stream systems and we can do things that are good for habitat that are also good for the health of system and also reduce the costs of surface water management. Trying to work towards a specific fish management goal, for a certain species, will lead you to artificial solutions to get a particular kind of pool or type of habitat. We have learned a lot about such things, and we are doing experiments and doing things that make more sense. We cannot just stop doing anything - we have to keep working and doing things smartly.

M. Miles: Matt Foy's talk was great. His focus was on low energy, stable streams. I would like to point out that it is inappropriate to transfer these methods into high energy, unstable situations. Scientists have a responsibility to ensure that money is spent in the best possible way. We need better criteria than we have now.

J. Bomford: The focus of this workshop was to be on urban streams. Much of the work mentioned today did not focus on urban streams. We need to make some decisions about whether or not we are going to spend money on urban streams for public relations, or for fish, or for both.

A. Haub: It takes a great deal of energy to accomplish something in an urban setting.

M. Foy: Culverts are really the only access to habitat in the urban environment. When the entire watershed is culverted, maybe there are healthy populations. Most watersheds in the Lower Mainland are not completely urban.

G. Lucchetti: What is urban? I prefer the term urbanizing. There are places that are on the fringe.

Participant: It costs millions of dollars to do restoration. There is millions of dollars available to do catch-up work on systems we have destroyed. Why is it so difficult to find that money to purchase leave strips along areas so we do not have these long term problems? Why is there no money to be proactive?

A. Haub: In Olympia, we did that. We bought a 160 acre wetland. It was virtually pristine. But development is coming in. What do we do? Do we keep buying up land for a mile around?

M. Foy: Think of the watershed as an apple. All we end up with is the core.

Participant: We spend a phenomenal amount of time and money going back and fixing problems. It would be a lot easier if we could just purchase a leave strip and that's it.

M. Miles: In Alberta, they do that. They buy riparian areas.

Participant: I like seeing these projects that enable people to get involved. But at what point do we tell people that we are only doing this because we have made mistakes in the past. How do we get those people thinking about avoiding the mistakes. Not necessarily purchasing land, but going to city hall and saying, we don't want to be doing this (restoration work) in 10 years time. Gino talked about the relative costs of protection and restoration. There are huge cost differentials - up to $1 to protect and $1,000 to restore. How do we break through this?

Participant: Typically, there is a great deal of angst that occurs at these forums, among levels of government. But we are all restrained by the political agendas at every level, in every agency. Until that changes, there is only so much we can do.

P. Scales: These are urban streams, where there are people. Maybe the point of the Urban Salmon Habitat Program (USHP) is to get people involved so they are educated, and perhaps these people will have an impact on the political movement in their community. It takes a lot of time, longer than one election. We all wish we could reach more people. We are, and we are doing it slowly. But the more people out there who are out there and understand they are trashing the environment, the more who can go to council to ask them to take action. Isn't that what USHP is all about? The way to get salmon back in the streams is to have people believe in and have pride in those streams.

Participant: On Vancouver Island, the environmental coordinator program's number one priority is to make the linkages between local planning and the stewardship groups.

Participant: DFO has had to carry a lot of other people on the backs of protecting fish habitat. People have jumped on the fisheries bandwagon, but we also need areas for terrestrial habitat, and areas for people. We cannot ride it all on the back of the Fisheries Act. The Fisheries Act cannot do it all. We need real change, i.e. legislation.

Participant: Restoration sells well with the public. It is easy to work with fish in steams. Protection is a negative business. We need the jurisdiction/legislation to be able to say no. People are terrible to work with. It is easier to work with fish.

G. Carlson: We have learned that we all need to work together. That is becoming more important as we work with dwindling resources.

Participant: How do we motivate the average citizen in restoration work? We need a marketing strategy. How do we translate the number of streams lost to the number of fish lost? We need to put it in economic terms, such as the loss of jobs in the fishing industry and in the sports fishing sector. That is missing in the Urban Salmon Habitat Program and the Watershed Restoration Program. We do not tell the public why we are doing anything.

M. Foy: We all want public advocacy. The strongest public advocacy comes from the small community hatcheries - they are tight groups, they are focused, and they are vicious. There is a slow absorption of information. The Port Moody Ecological Society is a good example - they started as a hatchery and eventually they changed the entire city council. We are talking about informed citizens, getting politically active, and doing what is best for the watershed.

G. Lucchetti: In the Cedar River, we identified all the things that we could do, and we put dollar values to each and put it into a report. That creates a monster, because people want to start doing all these things - but at least we have people moving and wanting to be investing in the system. Actions can

get a lot of publicity. I recommend that you start listing the things you could do and figure out the cost. You have to be aware of the cost of doing the wrong thing - a good example of not doing it right: we spent $5 million on a tiny stream you could straddle - it was one bad scenario after another. Conversely, in Rock Creek we spent $3.7 million and it was a jewel of a project. There are trade-offs.

Participant: We have good examples in Surrey - we have the longest and last remaining streams in the lower Fraser Valley. Approximately 50,000 people move to the Lower Mainland each year, and two-thirds of them come to Surrey. We are trying to fix past impacts and plan for the future with limited resources. We thank DFO for the Fisheries Act. If we did not have it 10-15 years ago, we would not likely have any streams left. Also, we have to remember the intrinsic value of these streams to our quality of life. Maybe species shift is not a bad thing. Is it bad to have cutthroat in the streams and no coho? We will try to conserve coho, but if we fail, we have not failed completely.

Participant: All urban land is of equal value. The development pressure is on urban land because it trades at full market value. Planning is the tool we need to use - we have to put a lower value on riparian areas in urban areas. For example the Agricultural Land Commission changed the problems of pressure on agricultural land, overnight, so that it was no longer sold for development. What about a tool like that to protect riparian land? This needs to come from the top down. With all agencies and municipalities involved, so there is some uniformity.

Participant: I sense that the public does not understand why governments are not able to protect habitats. We have done a terrible job of communicating that to the public so they can be our strongest allies to help us do our job. Scientists also do not do a good job of communicating to politicians.

SESSION 4: STEWARDSHIP

Chair: Val Schaefer, Douglas College Institute of Urban Ecology

GRASSROOTS ACTIVISM AND STEWARDSHIP - OVERVIEW AND CASE STUDY

Mark Angelo and Bob Gunn - B.C. Institute of Technology, Fish, Wildlife and Recreation Program

RESTORATION PARTNERSHIPS IN SNOHOMISH COUNTY

Robert Aldrich - Principal Watershed Steward, Snohomish County Surface Water Management

STEWARDSHIP IN THE COMOX VALLEY

Chris Hilliar - Fisheries and Oceans Canada

THE EMERGING ROLE FOR COMMUNITY BASED STEWARDSHIP GROUPS

Greg Mallette - Fraser Basin Council

PANEL DISCUSSION

GRASSROOTS ACTIVISM AND STEWARDSHIP - OVERVIEW AND CASE STUDY

Mark Angelo & Bob Gunn - B.C. Institute of Technology, Fish, Wildlife & Recreation Program, Burnaby, B.C.

ABSTRACT

Burnaby Lake System Project - Overview and Structure
(Mark Angelo)

The Burnaby Lake System includes the Brunette River, Deer Lake, Burnaby Lake, Still Creek and dozens of creeks and streams, many of which are still flowing and many of which have real potential.

The Burnaby Lake System Project is overseen by the BCIT Fish, Wildlife and Recreation Program, which acts as the coordinator. This role involves staff and students. We have a good working relationship with the City of Burnaby. We also work with DFO through our Community Advisor, Maurice Coulter-Boisvert. This Community Advisor role is an important position in terms of encouraging community involvement. We work closely with the provincial Urban Salmon Habitat Program, which is a very positive program. It provides important funding and encourages grassroots activism. In addition, we work with community organizations like the Rotary Club. The local media has been very helpful in profiling some of the work we have been doing. We also work with companies such as VanCity and Trans Mountain Pipeline.

The Program is broad-based in scope, but most importantly we have a large volunteer base who participate regularly in events like Rivers Day cleanups, streamside vegetation enhancement, and fencing projects. These kinds of events have increased public awareness, which in turn has reinforced political support. The Burnaby Lake System Project's focus has always been on the protection, enhancement and restoration of fish, wildlife and recreational values.

Given the broad support and diversity of participants, the project will likely evolve into a watershed council in the not too distant future.

Case Studies
(Bob Gunn)

The Burnaby Lake System Project formally began out of a community stewardship initiative to inventory, protect and enhance the Brunette River watershed. The highly urbanized watershed encompasses 7,200 hectares. While the watershed has many complex environmental problems, it also has some significant natural resources. Twenty percent of the watershed is protected within parks, conservation areas and green spaces. The watershed supports more than 200 species of birds, 23 species of mammals, and 10 species of amphibians. The watershed also contains 25 open and free-flowing streams, of which at least 10 have documented use by salmonids.

From the beginning, this Project believed that in order to effectively protect and enhance urban streams and riparian areas, the Project required two key elements:

1. The Project must advocate a watershed management approach and help and support initiatives reflecting this approach;
2. The Project must develop effective partnerships, including all levels of government, community organizations, local businesses and media.

The complex nature of the problems, the diversity of stakeholders, and the jurisdictional interests involved required effective partnerships to complement environmental initiatives, as well as the use of effective technical, financial and human resources.

In addition to our continued involvement in watershed management planning initiatives and processes over the past three years, the Burnaby Lake System Project has supported and conducted a variety of projects throughout the watershed to identify problems and potential enhancement opportunities. Many of these projects are reflective of the ways community stewardship organizations and government agencies can work together to support common initiatives and develop well-timed projects.

Much of our work initially focussed on inventory and monitoring activities. Through support of the Project, BCIT students have conducted a variety of fisheries, wildlife and vegetation inventories throughout the watershed. Studies were usually conducted at the request and under the direction of local resource managers, and have provided baseline information to government agencies, consultants, and community stewardship groups. While we have conducted some work on water quality and sediment quantity, we also realized that there were some aspects that are more suited to other professionals and technical people.

While these studies continue to provide exceptional educational opportunities and experiences for our students, due to time and other constraints associated with the program, these studies are generally inventory based. The studies identify sensitive and problem areas that trigger concern for more comprehensive technical assessments and the development of enhancement strategies through integrated planning processes. We primarily use the studies to lobby local government for greater concern and interest in the area.

More recently, our involvement has included enhancement and restoration activities. Project activities are primarily supported and complemented by local agencies and other stewardship organizations. Projects have included riparian enhancement work, spawning gravel placement and fish passage improvement projects on Eagle Creek, Still Creek and other areas. Design work is usually carried out by government agencies. In order to promote better watershed management practices, we have several stewardship and educational projects, such as educational kiosks, brochures, posters, etc.

The success of our work has been reflective of the cooperative partnerships that have evolved within the community. If we are truly going to protect these urban streams in our watersheds, these partnerships will be critical.

Discussion

Q: What kind of formal evaluation are you doing on the project?
A: We try to monitor most of the sites we work on. For example, for riparian sites, we try to monitor how successful the vegetation is. If it is less than 80%, we will revegetate provided there is funding available to do it. Students continue to do stream habitat surveys, when appropriate. We are finding that the demand for the students is increasing, so we are doing slightly less inventory and monitoring work in the Brunette.

Q: What is a realistic water quality objective for Deer Lake? Will swimming be the objective?
A: No, secondary contact is a more likely objective. There are too many pressures on the lake, especially from the Metrotown area. The Deer Lake ecosystem is in danger, so it is realistic to develop the lake for secondary recreational activities. So much has changed in the past 15 years. Council has not set secondary contact as an ultimate objective, but it is a realistic objective.

Q: What is your perception of the changes in the distribution of fish?
A: There will be many management problems on any urban stream system. We have seen positive signs - we had cutthroat trout salvaged in the upper part of Still Creek. We are concerned about the coho stocks - they are probably the most threatened in the watershed. We may see coho surviving in the lower part of the watershed and cutthroat surviving in the upper part of the watershed.

Q: To what extent is the public involved?
A: They are not extensively involved. We have organized community events to provide opportunities for involvement, but there are staff limitations to organizing ongoing involvement. We also have thirty students we can rely on to participate each year. We have organized community events and had tremendous response. There were about 300 people at the Burnaby Rivers Day event to do fence removal. We try to do as many community events each year as we can. We hope this project will become an umbrella organization, merging with the Burnaby Streamkeepers initiative, or it could develop into a watershed management council. We are working on that with the City of Burnaby. The city-wide Streamkeepers initiative has been a follow-up to some of the work that started in the Burnaby Lake System Project.

Q: You mentioned daylighting of Hastings Creek - it sounds like it would be an expensive venture. There is also a similar project in Seattle. There is a lot of debate about whether the money would be better spent on something else. Do you think money is better spent elsewhere? If you have money to restore a stream - how do you justify this, when you could protect another stream?
A: There has been a lot of publicity about the lost streams of Vancouver. There are approximately 50 streams which have been buried, culverted or paved over. Hastings Creek is a unique opportunity - the City has recently approved a plan to naturalize a large parcel of land where the PNE now sits. The plan includes re-opening of the Hastings Creek channel, approximately 1.3 km to Burrard Inlet. Part of it will be a wetland which will be used as a biofiltration pond for the stormwater that will be channeled into the area. It will be expensive. Vancouver will request to use about $4.5 million from the upcoming Federal Infrastructure Program for separating storm and sewer water in that area. The plan is approved by the Parks Board - the main factor as to when this will occur depends on when the City gets funding.

Q: In dealing with city councils, how have you approached cleaning up some of the stormwater discharges?
A: We sat through a number of planning processes to deal with the stormwater issue. It is very complex. In the Still Creek corridor, which supplies 40% of the water to the watershed, we are looking at the land use in the area to identify where we can incorporate wetland biofiltration ponds or other structures to mitigate some of the runoff in those areas. It is very complex, and often we do not have the land base in urban watersheds to put in big enough systems to act as natural biofiltration units. At BCIT, we are also looking at solar aquatic treatment systems. We hope to look at how effective it may be for treating stormwater runoff. It is traditionally used in sewage treatment. These systems can be highly efficient in very small spaces.

RESTORATION PARTNERSHIPS IN SNOHOMISH COUNTY

Robert B. Aldrich - Principal Watershed Steward, Snohomish County Surface Water Management, Everett, WA

ABSTRACT

Snohomish County has a growing population, and a mixture of urban, rural, and agricultural land uses. During the late 70s and early 80s, urban streams in the South County area began to show the effects of urbanization. As a result, citizens, politicians, and agencies began preparing watershed management plans designed to reduce the rate of degradation and to protect those areas that were exhibiting the most rapid decline.

These plans identified a clear need for a person, or persons, whose primary responsibility was action, and implementation of the plans. Thus were created Watershed Stewards. In Snohomish County, stewards serve as a focal point for watershed activities, as well as an initiating energy for weaving together the many threads that form the fabric of implementation.

Stewardship can be difficult to define because it means so many things to so many people. For example, stewardship for the community as a whole means caring for the land, conservation of natural resources, and generally coexisting with the natural environment. In the day-to-day work of a Snohomish County steward, stewardship means working directly at the grass-roots level, teaching in the classrooms, responding to citizen complaints, planning and designing on-the-ground projects, and working with other resource management agencies.

Such a broad stewardship work program requires interdisciplinary collaboration, the stewards assisting with many facets of the surface water management picture. For example, the stewards work with capital projects in terms of review and siting of projects, river management in terms of revegetation efforts, education efforts in terms of classroom teaching and workshops, monitoring efforts both in terms of citizen efforts and long-term ambient water quality monitoring efforts and responding to citizens complaints and requests throughout the County.

Some examples of active programs that directly involve watershed stewards include:

1. Native Plant Salvage

   A program that uses paid staff and volunteers to salvage plants from proposed construction sites, and then transfer plants to sites needing revegetation.

2. Watershed Keepers

   An educational program that targets the needs of specific watersheds, involving volunteers and paid staff in classroom and field settings.

3. Jobs for the Environment

   A grant program that funds unemployed timber workers for watershed restoration projects.

4. Cooperative Bank Stabilization

   A County funded program that matches citizen funds for protecting and repairing damaged stream and river banks. A primary tool for habitat restoration.

5. Volunteer Wetland Monitoring

A monitoring program that trains volunteers in wetland monitoring techniques in exchange for monitoring specific wetlands.

6. Watershed plan implementation

   A SWM funded function where staff are assigned as stewards to watershed where management plans have been completed.

In general, urbanization alters the hydrology, vegetation, and human approach to the landscape. Successful restoration efforts must encompass an amalgam of processes that occur at differing spatial and temporal regimes, while recognizing that some of the watersheds changes are irreversible. Within the context of irreversibility, though, the task of long-term stewardship must then focus on salvaging and protecting the remnants of functional ecosystems within the urban environment.

Discussion

Q: At what point do you think your council will figure out that restoration projects are creating watershed advocates?
A: When they are voted out. Their constituency is the development community, gravel mining, and the agriculture community. They will realize that it is the public that votes for them.

Comment: Your talk was uplifting and refreshing. It shows, by example, that what really counts is local action.

STEWARDSHIP IN THE COMOX VALLEY

Chris Hilliar, Fisheries and Oceans Canada, Comox, B.C.

ABSTRACT

Part 1. Defining Stewardship

We must shift our focus away from "Fish" in order to save fish and Fish Habitat!

Ever since I started in DFO I have heard the phrase, "Focus on the Fish and you wont go wrong! Maintain that focus!" Being an individual that is task oriented, not overly analytical, and likes to have a focus, it took me quite a long time to realize that focussing on the fish was actually part of the problem! So, what is the correct focus? The correct focus has to be on people - fish are not the problem - people are, or more accurately peoples' relationship with the land.

The difference between Protection, or Restoration, and Stewardship is simply one of focus and end goals. The end goal of habitat protection or habitat restoration is a product - the product being a fully functioning ecosystem capable of supporting fish. The end goal of stewardship, on the other hand is a state of harmony between people and the land; stewardship focusses on the relationship between humans and their natural environment.

Aldo Leopold said in his well known book, "A Sand County Almanac" that conservation was "a state of a harmony between people and the land". Stewardship, then, can be thought of as a pathway to conservation.

Stewardship involves people in activities with the end goal of changing their attitudes towards the land. When stewardship groups undertake habitat protection and restoration activities, those activities become a means to an end - a way of involving people with the land in an attempt to change their attitudes and their relationships.

Part 2. Stewardship in the Comox Valley

That is the purpose of PROJECT WATERSHED Society in the Comox Valley - to promote community stewardship, to change peoples' attitudes. The Society does that through what it calls its five P.R.I.M.E. activities - Protection, Restoration, Inventory, Monitoring, and Education. By involving people in these activities we achieve an output of protected or restored habitat but more importantly we start to change peoples' attitudes towards the land by involving them in outside, result oriented work.

Stewardship is not easy. Humankind's greatest successes have always been in the "mechanistic" category; we have excelled at building things, complete cities, transportation systems, putting men on the moon. We have done very poorly in the relationship field - socially we have high divorce rates, family breakdown, and increasing societal violence. Environmentally our relationship with the land has been disastrous.

Building strong positive relationships is hard work. At the community level it means among other things that people must have a means of coming together to solve problems. We achieved that in the Comox Valley through the creation of the Watershed Assembly. The Assembly is simply a monthly forum for private citizens to come together to develop strategies to solve water and watershed problems. The Assembly is not a round table of stakeholders or a watershed council that requires members to represent a group, an agency, or a corporation. The Assembly is for private citizens. It

functions as both an advocate and a catalyst. As an advocate it allows citizens to network and assist each other to solve problems and provides a link to appropriate government agency staff. As a catalyst, the Assembly can create round tables to deal with complex multi-stakeholder type problems or a Citizens' Action Team to co-ordinate restoration or protection projects. The Assembly's focus is always on process, on developing problem solving strategies and then monitoring the effectiveness of the process put in place.

Solving problems co-operatively at the community level often brings individuals together that already have a strong relationship - one built on antagonism, fear, and lack of understanding. But it is exactly at this level with private citizens coming together in small comprehendible groups to resolve conflict and solve problems that, I believe, we have the greatest potential for achieving societal change and re-establishing a way of life which does not destroy the land that feeds us.

Part 3. Moving Ahead

Finally I was told this was to be a technical workshop and to include some comments on how staff can make optimum use of stewardship initiatives in their own communities; and so I offer the following recommendations:

1. Get to know your local politicians - your town councillors and regional directors on a first name basis. Land use decisions that affect fish habitat are ultimately made at town council meetings. If you can't stand going to night time meetings or making presentations, don't! Meet with local councillors on a one on one basis and take them out to a nearby stream. Educate them! Inform them! Involve them! Inspire them! This could easily be the most effective thing you will ever do to protect fish habitat. It's called stewardship! Your are changing people's attitudes towards streams and wetlands!

2. Get to know your stewardship groups. They are our allies! They have formed a group because they want to rebuild a fish run or protect habitat - they have the same objectives that we do. Befriend them!

3. Develop negotiation skills! I consider all of us to be negotiators for fish and fish habitat. Most of us in this room deal on a daily basis with land use conflict. I believe that more and more of us will become involved in multi-party, whole system, planning processes such as watershed or estuary planning. This means we will be sitting down at tables with people who have conflicting agendas. It will be our role to negotiate the best deal we can for fish and fish habitat within the context of the whole watershed or whole estuary. We need to be good negotiators! I know of no better place to build those skills than at the Justice Institute of B.C. in New Westminster in their Conflict Resolution Program. Contact the Justice Institute, get a calendar of courses. Talk to your supervisor and put conflict resolution and negotiation skills on your next training request form.

4. Provide for regional networks and co-ordination! In a year long series of public meetings held in the Comox Valley citizens repeatedly told us they wanted LESS government authority and MORE government co-ordination. I believe the time is right to create a Georgia Basin-Puget Sound Conservation Network. This would NOT be a new authority but a flexible structure to support community-based conservation efforts. Through the designation of Conservation Districts defined along watershed boundaries senior governments from both sides of the 49th parallel could play an important supportive role in helping communities become self-reliant in resolving land-use conflicts and managing their own data centres of environmental information.

Conservation Co-ordination Centres in each district could facilitate co-ordination of government and non-government conservation initiatives. The Centres would most likely best serve small towns and rural areas as opposed to large cities. Rural areas face different problems than those faced by urban

centres and rural people have a different sense of community. We need conservation co-ordination for rural communities and we need senior government to help!

Discussion

Comment: Re: Political activism and taking a politician to the stream rather than going to the politician. In my experience with politicians, you get much more out of going to council meetings. You are in a public forum, so the community is aware of your issues. You get media exposure, and you can be the contact person for the media so you can keep the issue alive. If you take someone to a stream site, they can just forget about you.
A: Yes, that is true, but some technical people do not like going to council meetings. It is not the only place you can talk to a politician. You can meet one on one in an arena in which you feel comfortable. Preferably, you could do both.

Q: What is your role with stewardship groups in Comox? When do you wear your DFO hat and when do you wear your citizen's hat?
A: There are no streams in Comox Valley that are strictly urban streams. When you live in an area like the Comox Valley, you are known as a citizen first. It is the same for the politicians. You are simply a citizen and known for your actions rather than the hat you wear. I have tried to create a system which allows people to work together, in small groups. They do not have to much structure. Small is beautiful.

Comment: We often forget that we are citizens, and we have the right to tell our councils what we think. It is not necessarily lobbying or creating a conflict of interest, it is just citizens interested in their own community. You can do some volunteering and feel effective, and you will not feel as frustrated in your job.

Comment: We are used to a regulated world. We need to get out of our pigeon holes. You do not have to be organized. Movements start very informally - in the bar, coffee shop or on the stream bank. The most important organizations are the transient organizations that are often called "Friends of.....". The Wildlife Federation is becoming less of an influence. Greenpeace will likely become less relevant, because they are locked into big campaigns. The small, ad hoc groups can shift gears whenever necessary and take care of problems as they arise.

Comment: DFO's WWW home page will soon have a map of stewardship activity in B.C. There are about 500 stewardship groups that will be included. Within the month, there will be the ability for each group to update information on the site as they take actions. It is a tool that can be used for networking.

THE EMERGING ROLE FOR COMMUNITY BASED STEWARDSHIP GROUPS

Greg Mallette - Fraser Basin Council, Vancouver, B.C.

ABSTRACT

Traditionally, community based stewardship groups have focused on the rehabilitation, enhancement, and protection of small streams and rivers. Much of the emphasis has been focused on reacting to the environmental impacts associated with development. Development referred to here is associated with all human activities ranging from agricultural and urban development, to forestry and industrial operations. In the last decade it has become apparent that this approach is not working as effectively as once thought.

While community groups are effective at working in and restoring small portions of watersheds, it is all too often the case that years of work is degraded or jeopardized by short term activities associated with development upstream in the watershed. Or the years of work really do not contribute significantly to the overall health of the watershed. For this reason the successful community stewardship group must engage in joint planning activities with government agencies and development interests in order to protect their investments in rehabilitation and enhancement work and watersheds in general.

While many community volunteers, and the agency personnel who work with them, often express the need to get down and into the creek "to do something" versus "going to meetings" and engaging in planning, their future success will depend on how effective they are at the altar. A number of case studies are available that substantiate the need for community stewardship groups to evolve into a planning and lobbying entity to go along with the more traditional rehabilitation and enhancement roles. Examples will be drawn from experience in the Ryder, Elk, Alouette, and Salmon watersheds of the Fraser River Basin, as well as from the upper Columbia River Basin.

Discussion

Comment: I work for an environmental group where our membership comes from the commercial fishing industry. Our constituency wants to save salmon and protect streams. We were always an advocacy group and then we started getting into restoration. We realized that many of our members wanted to do it. Then more people got involved in advocacy once they got connection with the streams. There is a big public sentiment growing regarding saving salmon and salmon habitat. We can build on this, but how? Basic political will does not exist right now, so what can help stewardship groups? 1) access to information; 2) access to processes (and meaningful input into the processes); and 3) listen to what people are saying. People are our best resource.

A: There is a need for the social side of stream protection. The establishment of minimum flows on the Alouette River was a really positive achievement - it went from 20 cfs to 100 cfs - due to the efforts of motivated citizens. They created five acres of habitat for only $60,000.

Q: Do you think there is enough momentum for stewardship groups to spontaneously appear as necessary or is there a need for government seed money?

A: There is a need for seed money for building capacity. For example, the Halifax Green Plan money was used to build community partnerships. The focus is moving away from technical solutions to working on habitat and building capacity and community stewardship.

Comment: DFO and USHP have accomplished a great deal. The Pacific Streamkeepers Federation (PSF) is still getting established but it is driven by volunteers and supporting local groups. It will be freestanding from specific government programs and ongoing. Support to an organization like PSF would be useful.

Q: The impending development in the Ryder Lake area will be tremendous. I hope the stewardship advocacy will be effective in the urban fringe. There are major battles coming in the eastern Fraser Valley. We need protection there. How do we learn from our mistakes and transfer that knowledge to the future? How do you motivate when the problems are not there yet?
A: There are many groups in Chilliwack. After about a year and a half, one group almost has enough capacity to deal with agencies. Where do we want to spend our money - daylighting streams at $1 million per mile?

Q: Do government agencies really approach community groups with a good understanding of the motivations and needs of the groups?
A: No, not in the Columbia basin. Here, in the Lower Mainland, bureaucrats are more progressive and have more of an understanding of the role community groups play.

Comment: The Provincial Watershed Alliance will be providing information to local organizations who want to get established. It is looking at providing money, but we are now reliant on agencies that are willing to help us.

Comment: Volunteer organizations have the initial energy to pursue activities, but it is difficult to sustain that energy. It seems to be worthwhile expenditure for all agencies in the Lower Mainland to contribute (e.g. B.C. Hydro, GVRD, MELP, DFO, municipalities, etc.). There is a long term commitment ($) needed to fund a person as a watershed coordinator. There is no mandate to do that.

Comment: We are talking about stewardship - educating local citizens. Fundamental change comes from groups with no ties to government and only ties to the resource. They demand - they do not ask. We are lacking true high level political action and requests for change in B.C. The change in the forest industry in B.C. was driven by people with no political ties. They should not be talking to bureaucrats, they should be talking with politicians.

Q: I consider activist groups to be my closest allies in my job. But these groups are constantly marginalized in council chambers. How can the process empower these groups?
A: It is just war, they just need to outlast people. Advocates last longer than bureaucrats. It takes a certain type of personality to be willing to fight like that.

PANEL DISCUSSION

Participant: Across North America, there is a movement towards community involvement. The success stories have been those that, on their own, found a problem, took some ownership for it, and found their own solutions to it. The groups that were pushed or seeded by local or senior governments did not work.

B. Aldrich: I agree, we are trying to patch together ecosystems with silly putty called "technology". We can never restore an ecosystem to what it used to be. Citizens' groups should spend their efforts on protection of the resources we have.

C. Hilliar: The groups that are the most effective know the problem which they want to solve, and they spend time clarifying what the problem is. The best book on creative problem solving I have read is "Breakthrough Thinking - the 7 Principles of Creative Problem Solving". It lays out a really good process for problem solving.

B. Aldrich: Nothing frightens a politician more than an informed, focused local public.

Participant: I disagree - the most successful groups are those that evolved from the Community Advisor programs. They got very action-oriented - adopted streams, had pet projects, did a lot of restoration projects - groups like Langley Environmental Partners Society. The ownership of the stream is a stage they have to go through. You cannot get a group into ecosystem planning. They will walk away in a few months.

B. Aldrich: There is a delicate balance. Groups need action projects, but they still need to look at the big picture, and attend council meetings.

Participant: It is a transition people go through - once they get hands-on involvement and personal identity with the stream, they may just become amateur biotechnicians. Then what? We need processes so they can move on from there. Some of those people will come forward and put up with the Monday night council meetings in order to make it all worthwhile. But they have to get their feet dirty first.

B. Aldrich: In Canada, activists sound like true activists. In the U.S., they get co-opted by developers. Then they go to sleep. The environmental legislation that protects our wetlands is politically compromised to begin with, and is constantly getting further compromised with each development. With local government, everyone is your constituent and everyone is your client. Whoever makes the most noise gets attention. If you are in their face, bureaucrats and politicians will call back.

Participant: A few communities have seen stewardship really work. The City of Port Moody has made a decision to hire an environmental coordinator on their own, without any agency money. That individual will only report to the mayor. We need to see more of that.

B. Aldrich: The most effective model I have seen is in King County, in Bear Creek. Bear Creek has Waterways 2000, a Basin Plan, a good steward and active citizens. The Steward reports directly to the politicians, and the citizens report to nobody.

Participant: We all see things that the stewardship groups could use and actions they could take, but they have to want it and ask for it. They need to discover it for themselves.

Participant: Many have already discovered it, such as the sport fishers, commercial fishermen, naturalist groups, etc. They have been raising their own money and following their own mandates for up to 50 years. We have to get the established groups together with the newer, enthusiastic groups. Older groups are burned out, but they know the ropes. They need to team up. Government agencies have to decide what role to play in that process.

Q to B. Aldrich: There has been a lot of good work in the U.S. on controlling range impacts on riparian vegetation. What are the U.S. laws on how much riparian area you have to have on private land, and how are you getting good results?
A: It depends on the local area. There is no legislation in Snohomish County.
B. Fuerstenberg: King County has a pending ordinance for a fence setback bylaw. Farmers also have an option to develop a farm management plan. There are fines for non-compliance.

B. Aldrich: We have voluntary programs in Snohomish county. As an example of the apathy, we had $50,000 available to spend on fencing - we could not get any volunteers to let us fence their land. They see it as government interference in their private lives. In eastern Washington, in the Columbia basin, there has been a tremendous amount of support, just because it is the right thing to do. Riparian restoration has been demonstrated to be the way to go in terms of water and range conservation.

Q to B. Fuerstenberg: How do you get an ordinance passed for fencing of riparian areas in King County?
A: It was part of our sensitive areas study. Council was pressured by citizens' groups and the tribes. The tribes have power through co-management agreements. Council passed an ordinance which gave people three years to implement farm management plans. If people do not implement plans, we will fence their land. They will pay for it, or we will develop cooperative programs. In the U.S., the Soil Conservation Service has co-op programs to pay 60% of the costs of fencing. Not many people have taken advantage of that program, but there has been improvement - farm management plans are being put in place and some fences are going up. The Soil Conservation Service is finally demonstrating that farm management plans make good economic sense. We have not seen what would happen if someone does not put a fence up. The Department of Health could close down operations.

Participant: Regarding the question about what kind of stewardship models work - there is no perfect model - the circumstances are different everywhere and have to be tailored. The structure will determine a lot about the outcome. For example, the new Nechako Watershed Council has been set up and there is a hope that this is a great step forward. There is a great love for multistakeholder consensus programs, but Alcan (which operates a large hydro dam on the river) has access to the decision making process - they can veto anything. That does not work. It could work if there is a timeline and a decision making process that government will listen to.

Participant: There is a different situation in Ontario, with the Conservation Authority network. They have taken on a stewardship role, and the Provincial Ministry of Natural Resources is the "hammer". The Conservation Authority follows the U.S. idea - the mandate is water, but it is also a funnel for organizations to get funding from various sources for fencing programs, re-planting, etc. People who work for Conservation Authorities (which are funded by municipal and provincial

funding) do not threaten the public like the provincial authorities. Here in B.C., there is a stigma of provincial and federal agencies as "big government".

B. Aldrich: In Washington, we also have Conservation Districts - they are an arm of the counties. They work with the farming community - they are also not seen as the "hammer".

Participant: In Ontario, there was a unique situation with Mennonites, a conservative group of farmers, involving fencing programs. The Conservation Authority initially approached leaders in the community and got the support of the leaders. It was then easier to get the support of the entire community. We can use that model. You have to get to the effective speakers in the community.

Participant: The Urban Salmon Habitat Program is entering its second and third year of five year program. The concept of the program is in working with stewardship groups and local government in a community, and bringing them together, so there is a permanent infrastructure in communities when the Program is over. We should not put money into stewardship groups in a haphazard manner. It is important to establish an umbrella organization, so that groups are not competing with each other. They are the natural resource advisors for the future in a community. The hope is that we will see some seed establishment of such a local community infrastructure to permanently look after the natural resources in that community.

Q to B. Aldrich: Do you get stewardship groups who work closely with local governments in Snohomish County, and how?
A: In Snohomish County, there is a fear and distrust of county government. The government is pro-development and pro-extraction. The environmental groups are invisible until there is a big issue that they can argue about.

Q: Does local government give them any time of day at all?
A: No, they do not. For example, the Property Rights Alliance posts someone outside council chambers each day. Environmental groups have been so beat down by politics, they just do not show up. It is very difficult to nurture those. We try to support the stewardship groups however we can, by providing buses, equipment. We have to gently bring them back in.

WORKSHOP REFLECTIONS

Chair: Mike McPhee, Quadra Planning Consultants Ltd.

REFLECTIONS BY:

Karen Milne, Resident, North Vancouver, B.C.

Otto Langer, Fraser River Action Plan (FRAP), Fisheries and Oceans Canada, Vancouver, B.C.

Thomas W. Holz, SCA Engineers Inc., Lacey, Washington

Karen Milne, Resident, North Vancouver, B.C.

If we can look back - at the beginning of this workshop, there was some mention of protection. But, for the last two days we have been hearing about restoration - repair, rebuild, patch up and fix.

Eric Bonham, concerning the Urban Salmon Habitat Program, has said that about 25% of municipalities in the Georgia Basin have made a commitment to protect stream habitat. This means that 75% have not. In order to increase participation, each municipality must be approached and convinced one at a time. This is a difficult and time consuming task for individual members of the public.

Individual municipalities have the authority to determine land use within their boundaries. Some, mostly outlying municipalities, still contain natural streams. But, in the near future, under pressure from population growth, many of these streams will be under threat. What to do?

One possibility and a broader approach would be some form of Riparian Protection Legislation requiring municipalities to protect stream corridors. However, this in itself could be viewed as a violation of private property rights, not just by developers constructing new complexes, but by individuals - people like you and me - who happen to live next to a stream within the riparian zone, and are concerned about their own ability to renovate, or to rebuild on their property should their house be destroyed. These are legitimate concerns.

Considering policy creation, we have three groups involved - senior government agencies, the local bureaucracy (council and staff) and the public. But policy changes are essentially driven by political will - the public viewpoint. (Earlier speakers today mentioned the numbers of people taking part in stewardship projects, numbers which initially seem impressive. Whether 300 or 3000, the percentage representing the overall population actually translates into something like less than one half of one percent.) The fact is - the majority of people do not know that there is a problem. When they look around, they see water, trees, birds. Problem, what problem? And if the goal is to prove to them that problems exist, then the responsibility should also be to provide a solution, or to involve people in creating the solution.

If we cannot count on provincial riparian protection legislation, then we deserve a provincial commitment to protect stream corridors where possible. And there is a way. Although municipalities control land use, not all public land within their boundaries actually belongs to the municipality.

One example - when most municipalities were formed, a street layout was created - usually by superimposing a grid over the landscape, usually ignoring topography. As a result, there are instances where street or road ends abut streams, and are part of the riparian zone. Roads and streets are generally under the jurisdiction of a provincial ministry. If a municipality wishes to “close off” and own a road end, then they would request closure an seek a transfer of title from the relevant ministry. Usually there is no real need for a municipality to request ownership - to hold title - unless they plan to sell and/or develop the site.

It appears as if transfers occur without site evaluation. The question is - why is the provincial government transferring title of ESAs - Environmentally Sensitive Areas, which includes stream corridors - to local governments? Why are they being transferred with no site evaluation to determine if habitat areas are involved? And why are they being transferred with no controls in place to ensure protection?

Perhaps now is the time for the provincial government to “set a protection example” by creating a Riparian Land Reserve - at least on lands, such as road and lane ends, and unused rights of way traversing stream corridors, which are already under provincial jurisdiction. These separate stream parcels can typically account for 25% of a watershed.

Otto Langer, Fraser River Action Plan (FRAP), Fisheries and Oceans Canada

This workshop hosted an excellent series of presentations and floor discussions. It began with the theme of protection, restoration, and stewardship. During the workshop discussions it became

apparent that the struggle to maintain urban streams took on the form of two sub-plots. The first was that of the technical world which mainly involves protection and restoration; the second was that of the social/political world which drives protection, restoration and stewardship efforts.

Views presented in the technical session were negative and positive. Unfortunately, the presentations on protection and restoration initiatives indicated that we are not as successful as most of us had hoped. Although we put great effort into protecting and restoring the natural values and processes in urban streams, we are still experiencing a net loss. This appears to be a common theme from both British Columbia and Washington State.

Many have stated that this observation is nothing new. However, to be able to bring 90 scientists, government workers and the public together and agree on general trends allows us to determine a baseline and determine how we take advantage of the successes and move forward. To not do that is to maintain the status quo - continued loss.

Many attempted technical solutions simply do not work as applied. Most failures are of the instream type that unwittingly attempt to replace a lost stream function or process. These restoration structures often fail during high energy flow events. However, technical fixes will work when selected to do a specific job and properly built in the right location. Side channels can improve fish habitat in a constrained stream channel. Detention ponds work when designed for a specific need. Erosion control is much more effective than sediment abatement efforts. Information clearly spells out that the wider the setbacks around a stream the more effective they are. Finally, reducing impermeable surfaces to an absolute minimum appears to be the best solution to many hydrology problems.

The good news is that there are solutions to many of our problems. The bad news is that the urban watershed is a complex environment and we most often do not apply the best tools in the proper way at the appropriate time or location. The greatest weakness is that we do not apply the proper degree of protection to the watershed which gives rise to stream processes that create habitat. Instead, we apply remedial solutions such as stream restoration after the problem has developed. We most often apply our efforts at the wrong end of the development process and in the wrong location (i.e. in the stream instead of on the landscape). We can spend millions in stream restoration but that will not restore the watershed functions that create healthy streams.

We do this because society does not have the will to insure that good land use planning will protect key features of the watershed that should not be developed. To proactively protect a watershed would result in greater conflict with property owners/developers. Instead we apply a level of compromised protection. We then try to correct the problems created by an excessive development footprint in the watershed by working in the stream with a variety of restoration techniques. These techniques were summarized by one speaker to be little more than sticks, stones and holes.

Given that more effort must go into protection than restoration, why do we put countless more dollars into restoring a stream than in the prevention of damage? Restoration is sexy! No one will object to humans cleaning up the messes they have created. It's like a blue box - it makes us feel good. It's also easier to work with fish and streams than it is to work with people so as to prevent them from causing the need to restore the stream in the first place.

Despite this, we should not be negative about restoration. We have a lot to restore, but restoration must be put into context. Restoration is an after-the-fact initiative. Restore what we must, but put greater focus on preventing future losses. This latter approach must incorporate the watershed and must be ecosystem driven. Restoration is an admission of our failure to build urban environments incorporating provisions to sustain the watershed. If we can protect the watershed, it can then best maintain the natural processes that will create habitat that sustain healthy fish populations.

We can make the transition from restoration to protection through partnerships and stewardship initiatives. Here we must make a much bigger dent in the socio-political part of the process. Successful stewardship initiatives vary from area to area but overall, there is an urgency to make greater progress quickly. It is an absolute priority that we get stewardship into city halls and into the boardrooms of our land owners and developers. Stewardship groups have evolved from working with fish, to working with habitat, to now wanting to be part of watershed change. To successfully do that, we must have the public influence our governmental and corporate leaders. Once the bottom up process works we can then have the leadership that is necessary to allow proper planning and stewardship of the landscape. Only once that is done can we have effective protection of our streams.

Concepts of law, leadership, development guidelines and stewardship were discussed. They are parts of an interactive continuum and not a serial process. They all belong in our tool box and must be applied at the appropriate opportunity. Once effective stewardship initiatives are in place, we can dig into our social/political tool box and connect people to streams and then reach into our technical toolbox and reconnect fish to streams.

In conclusion, if we do not take a very different approach in protecting our streams, they will continue to be victims of our growth dependent socio-economic system. The development rights of the landowner greatly outweigh the collective rights of the public to have healthy watersheds. However, it is the healthy watershed that is the true indicator of a sustainable future and a high quality of life. It is obvious that urban developments, characterized by excessive pavement, fragment the processes and ecology necessary for a stream to survive. Protection of the watershed is in the public interest. Watershed protection is possible through ecosystem based watershed planning. It is a concept that many talk about but few have shown the leadership to effectively put it in place.

This is not new thinking. It was eloquently stated by Aldo Leopold in his 1941 Sand County Almanac. Put very bluntly, we must develop a land ethic. Our streams would have a better chance if this 50 year old book was a reading requirement for our politicians before they filed their nomination papers and well before they voted on their first land use rezoning application.

Thomas W. Holz, SCA Engineers Inc., Lacey, Washington

I speak particularly to the "Prevention" part of the conference. I believe that the restoration work going on is important, but feel that the greatest effort and greatest rewards will be found in pursuing prevention.

- Papers that focused on "prevention" that I wish to recall for summary include those by Castelle and Holz.
- "Riparian Vegetation Effectiveness", Castelle and Johnson. This paper lends encouragement to the notion that fisheries may have a chance in urban settings if, as one condition of development, a sufficient buffer is preserved intact. Castelle proposes that in most cases buffers provide near maximum effectiveness if they extend at least 100 meters from the bank. (Note: Another paper suggested that a stream bed meander course of 7 times the stream's width bank to bank should be preserved to allow the stream to move and recruit gravel. Coupled with Castelle's assertion for buffer width need, the implication is that ideal stream corridors should be 200 meters plus seven times the stream width.)
- The Holz paper "**IS THE LOSS OF HABITAT INEVITABLE WITH URBANIZATION?**" complements Castelle's paper and addresses the other half of the equation: limiting "effective impervious surface". He proposes that models for urban development in use as reflected in current development standards and "Best Management Practices" found in the most recently adopted drainage standards have not worked; it has not been demonstrated that they will work. On the contrary, our best guesses about their possible effectiveness, as reflected in continuous flow modeling results, indicate that either flow peaks and/or flow duration will increase with urbanization. Modeling and observation has shown that so long as impervious area is "effective" (which is to say connected to the stream) for 10% of the watershed stream devastation is imminent. None of the urban drainage standard models propose limiting effective impervious levels below 10% in a watershed. Holz proposes that the current models for urban development should be abandoned and a "zero discharge" model such as provided by patch cut logging paradigm should be adopted.

Regarding action which should follow as a result of the insights provided by all speakers, it is recommended that agencies with responsibility for habitat preservation and restoration consider the following approaches and strategies:

- Jurisdictions without modern drainage standards should adopt them as soon as possible. Even though standards such as those presented by Kelly Whiting may be inadequate to protect fisheries, they are still better than nothing and they are an easier sell than other more radical changes that may be necessary.
- Regarding restoration of riparian zones in already built up areas, it is recommended that we take a much longer view of accomplishing the goal of 200+ meter corridors. Each jurisdiction might establish funds (from stormwater utilities) to buy back riparian zone a little each year that have been sold off and developed. The land should be restored and put into a trust that would prevent any use incompatible with habitat protection. The program should be implemented with the knowledge that it may take the same length of time to regain the lost riparian zone that it took to lose it: perhaps 100 years. The streams, the fish, and people will be here longer.
- Regarding other strategies for getting riparian zone back into public control: every level of government when buying land for public purposes (such as public buildings; public art projects; maintenance yards; parks; etc.) might be mandated to look first at parcels that include riparian zones. Land purchases for such purposes would be increased to allow riparian zone preservation.

- Government agencies such as Parks and Fish & Game should be mandated to accept gifts of land of any size containing riparian zones.
- Government agencies, such as Department of Transportation, that must perform construction projects in riparian zone should be required to mitigate by putting into public ownership five times the stream corridor that was taken for the project. (Should apply to retrofit projects as well).
- Form non-profit fund raising organizations such as the Costa Rican "Children's Rain Forest" to preserve Canada (and US) watersheds and habitat corridors in developing areas.

Regarding the Need to Lobby for Habitat Protection

The first answer from a legislative body to a request for change, a request for funding, or a request for action is usually "no" regardless of the merits of the request. Try the "front door" first (Howard Paish) but accept without a trace of discouragement the possibility (probability?) of rejection and plan to get community or legal support to force action.

Discussion

Participant: The toolbox for municipalities on acquisitions is quite empty. The City of Surrey is making concerted effort to purchase leave strips in riparian zones. However, Surrey's 5% or 15% dedication requirement for development is not enough to do it, especially when the Parks Department has to develop active playing fields. The mandate to protect riparian zones should be placed in legislation so that they are not be part of the 5% dedication.

M. McPhee: Planners should be lobbying for that kind of legislation. The Forest Practices Code Act has a provision for private property acquisitions. They are working on a strategy on how they should be prioritizing private lands for acquisition. It has to be a partnership - you need matching funds.

Participant: There is no one silver bullet for protecting riparian lands. The parkland dedication is only one tool - in many cases it will not be enough, and you cannot do it at the cost of manicured ball fields, for which there is also a demand. We can use rights of ways and highway dedications to secure bigger parcels of land - this is not being used very extensively by regional and municipal governments. Density bonusing can be used in exchange for dedication of riparian lands. Outright acquisitions can be achieved by using capital investment funds in municipalities. We can lobby so that municipal lands that are environmentally sensitive remain in the public domain, and are not sold and re-zoned for industrial uses. Land trusting works well - you can usually get $5 for every $1 you put up. We need a big lobby of the B.C. Assessment Authority. They set the assessment rate for conservation lands. They could trigger tax incentives for people to leave the land along and keep it free from development. Farmers are currently penalized for not using all the productive area on their land. We need to lobby B.C. Assessment to shift priorities. Many tools are not being used to their potential.

Participant: Regarding the street ends - there are 179 street ends at Lake Washington. They have been vacated. Often the road right of way extends into the creek. A group in Seattle is looking into this issue.

Regarding the public not knowing the problem - yes, governments need to be less formal about what they will hand out to the public.

Participant: Politicians respond to voter pressure and the media. The public gets most of its information from the media - use it! The media likes to see community action, and they like anonymous tips or just a phone call every so often. We need more exposure on television and in the newspapers to build public sentiment.

K. Milne: Sometimes that kind of exposure makes local councils defensive. It is not always beneficial.

Participant: Yes, so we need a whole range of things to do to increase exposure of the issues.

O. Langer: There was probably more media coverage a few years ago. The media is largely controlled by a few players who are against giving more publicity to certain issues.

Participant: I think you can bypass that. Stewards have masses of citizen groups they can call upon when issues arise. They have nothing to lose by offending council.

Participant: This conference was desperately overdue. I hope that this is not the end. We should continue our relationships with our colleagues over the border - we could create a Pacific Northwest Urban Streams Coalition or something similar. We just need some way to capture the energy - we could use technology to our advantage to achieve this (e.g. computers, internet). I am not convinced that our politicians have captured the seriousness of the urban scene. We must do whatever we can to make sure that this issue is kept at a high profile. How do we do that - where do we go from here?

Q: What is planned in the future regarding Urban Streams, south of the border?
A: *T. Holz:* The Salmon in the City conference is coming up in March 1998. All of us realize that it is time to stop talking and time to start doing something. The upcoming conference will be a call for action.

Participant: There is more going on in Washington State. We are working with the University of Washington on projects for watershed based indicators.

Participant: Perhaps the American Fisheries Society can play a role in putting on more workshops like this.

M. McPhee: There are not going to be any quick fixes, overnight. Charles Lindblom, a political scientist wrote a paper about “muddling through”. He looked at rational planning and decision making, and found that more had been accomplished by muddling through or incrementalism. Do not forget the power of incrementalism. I hope we have all come away with some fresh ideas that we can all apply in our own way.

DINNER PRESENTATION

URBAN STREAMS - WHERE HAVE WE COME FROM AND DO WE KNOW WHERE WE'RE GOING?

Howard Paish, Howard Paish & Associates, Nanoose Bay, B.C.

URBAN STREAMS - WHERE HAVE WE COME FROM AND DO WE KNOW WHERE WE'RE GOING?

Howard Paish, Howard Paish and Associates, Nanoose Bay, BC

My topic is "Where have we come from and where are we going?" Earlier today Tom Holz (Washington) gave us a good text, and it will underlie much of what I'm saying tonight. Tom said, "If a second coming of Christ was a good idea, and if the government was involved, it wouldn't happen without lobbying." That has been a constant in my life ever since I got into these sorts of games a long, long time ago. No matter how good the ideas are that we're batting back and forth today, at some time all this has to get into the system, and into the way in which we make decisions. Call it lobbying, call it what you like. Understanding the lobbying process isn't a dirty word, or a back door thing. It really involves understanding how government works and how to intervene for your cause. A lot of very effective lobbying goes on through the "front door", as it should; that's the best kind of lobbying. I'll be coming back to that, as some of you won't be surprised, several times tonight.

Since we are asking, "Where did we come from, and do we have any idea where we are going?", I'm going back to the kind of things that have me talking here on a Monday night after my wife has retired and three days after my 67th birthday, when I could be enjoying my grandkids and all that sort of thing. It gets back to what Eric Bonham touched on this morning; we have to "cojoin", he said (that must be a Scottish phrase, I think). We have to cojoin politics, technical considerations and education to create a massive consciousness change. I don't think we'll get that far, but I think we have little choice but to move that way. What we have to do ties right in with the theme of this conference. We are talking about "Impacts, Protection, Restoration, and Stewardship", and it is the stewardship theme that I emphasize because I think that is a very badly neglected, but essential, vehicle for acting on the other three points. This morning, the first four speakers set the tone for what we need to talk about.

The speakers this morning all pointed out that we are facing a pretty dismal picture. That makes things rather nice for me, because I didn't want to have to be the bearer of bad news. I'll try to be a bit more upbeat, since it is an after dinner speech. Whether we like it or not, it's people - not just streams and all the neat technical stuff - that we are really going to be talking about for a couple of days. In 1961 there were 890,000 people in the Fraser Valley. I remember that about 4 blocks from here, sometime in the early 1960s, meeting with the old Lower Mainland Regional Planning Board staff. A bunch of bright eyed young twenty somethings, including Dennis O'Gorman, now the current Assistant Deputy Minister for Parks, Rick Hankin, now the director for parks in the GVRD, and Erik Karlsen, now in Municipal Affairs. They were all running about thirty years ahead of their time. They were pointing out then that we had a population density in the Fraser Valley the same as Holland. It was a good line that really impressed people. When you compared Holland with our North American wilderness and the huge back-country that BC enjoys, it brought a very realistic perspective that people identified with. That is where the immigrants were coming from then. In 1991 we had 1.8 million people in the valley, and by the year 2021 it is going to be 3 million. That is the reality; we're probably not going to do much about it. But that's the background to what we are talking about, and let's start at a personal level because that is the starting point for anything that happens on the stewardship front - personal commitment and values.

Where did I come from, and what motivates me to do what I'm doing tonight? In his introduction, Otto (Langer) referred to me as an adult educator and a teacher. That's my original training and profession. I have been a non-government organization director for about 15 different groups in

Canada and a couple internationally. I have put in 9 years as a staffer for non-governmental groups, and I have been active politically, as a candidate (defeated), a campaign organizer, a ministerial advisor, and speech writer. To fill in the 25th and 26th hours of the day, I have been a wilderness guide outfitter and a consultant. It's from that mix of perspectives that I'm speaking tonight. I've found that in the lobbying game if people can see that you have sat in somebody else's shoes, and have seen things from both sides of the fence, but remain consistent, people pay attention.

Where did it all begin for me? It was George VI Coronation Day, May 12, 1937. On a little creek called the River Dickler, in the Cotswolds in England. I was seven years old, and I recall it vividly - there are certain seminal moments in your life that always stay with you. I recall two years earlier being wound up in a Union Jack taking part in a pageant and singing Rule Britannia, Land of Hope and Glory and God knows what else as part of King George V Jubilee local celebration. I didn't relish a repeat. My Granddad and I played hooky from the Coronation Celebrations, to the annoyance of the womenfolk around, and we went fishing. I used to love sitting on the bank of the river and coaxing him into telling me about the Boer War (he mentioned Gallipoli and the Dardanelles but he never talked about that much until I got older). Most important though, he opened up a lifetime vista to me through just being in harmony with a stream. I recall as vividly as I'm standing here today getting that first trout bite. That stream experience was really something that stuck with me and motivated much of my early interest in conservation and in lobbying for it.

As I've grown older a new dimension has taken over - seeing that little stream as a signal of hope for stewardship and the future. The stream was no more than eight or nine miles in length and twenty feet at its widest. Sound familiar? I was back there 12 weeks ago standing by the same hawthorn tree, looking into the same pool, and seeing the progeny of the wild brown trout that I caught 60 years ago. In August I'll likely be there fishing for them again, although I seldom sport fish anymore. That stream is sitting within a two hour drive of thirty million people and it gives me some confidence that if we can get some sense of stewardship in place, perhaps there is some hope for the future. I didn't really think much about all of this until I got to North America. Nobody had to read me a definition of stewardship. I just grew up with it. If I wanted to fish I had to learn that certain things had to be done around rivers. If I wanted to shoot rabbits and pheasants, then certain things had to be done to keep that happening. The notion applied to the farm, to the garden and to the beautiful countryside in which we lived. That's how I learned stewardship; there was no formal definition for it. And I guess the big difference between that and North America, is that when I got over here, I was quite surprised that I couldn't find that same stewardship obligation. Sure, over there the stewardship was vested in a small group of people who had access to those resources; that's the way it worked. It's not that way now; far more people can get involved in it. Stewardship is still very much alive, and it has become much more democratized.

When I got to Canada in 1954, and landed in northern Saskatchewan, with ducks, grouse and pike everywhere (as the old man said like a donkey being dumped in a strawberry patch), it was great for the first two months, but then winter hit. I started reading brochures about British Columbia, came to the West Kootenays a year later, and immediately got involved in Fish and Game Clubs. This was in the mid-50s, and I learned that all I had to do was pay seven bucks for a hunting licence and two bucks for fishing licence, and that seemed to be the end of the obligation. Resources belonged to everybody, and except for a handful of people, who I quickly found myself chummed up with, nobody really worried much beyond that. The whole common property concept was new to me, and I still haven't got that used to it. I realize all the things that we do in stewardship, creating community groups and all that sort of thing, are all trying to create a sense of stewardship - but it's slow going. Our democratic right to wipe ourselves and our planet out is alive and well.

My background is originally in the social sciences, and I think I understand how the common property concept happened. The people who came to this continent 200 hundred years ago were the

"have-not's" under the stewardship system in the "Old Country" and intended to set up something absolutely different. Everyone had an equal right of access - and unfortunately, an equal right to screw up rather than getting it right. Maybe we're getting to the point where we all could think a little bit more about this two hundred year experiment in managing public resources, as we see what's happening to our forests, fisheries, and all those resources that we all own but leave only a few to care for. I hope that that's really what we are getting back to with a lot of our current stewardship talk. We're trying to make people appreciate that they have a personal first-hand responsibility and obligation to take care of the resources that nurture them and that they own, and not to rely on someone else to do it, whether it is in a political system, a bureaucracy, or just putting a few bucks across the counter to buy a licence.

I ended up in the West Kootenays (and this is all leading somewhere, don't worry) at the time the Columbia River Treaty negotiations were underway. I realize I'm talking today largely to a group of government people, and there aren't very many citizen groups represented in here (a handful), but I give this message to them as often as I can, and it's the same message for you government people. What impressed me immensely when I first started going to Regional Fish and Game meetings, was all these guys who didn't wear the Game Wardens uniforms. These were professionals who made fish and wildlife a profession, like many of you in this room. I knew all about game keepers but these guys were fisheries biologists, wildlife biologists, who had degrees! I'm talking about Glen Smith, Don Robinson, Jimmy Hatter, Frank Maher, Pat Martin, Bob McMynn and all those sort of people who some of you I am sure remember. These are the people who helped train the current "bunch", including some of you. As professionals working for government, those people understood the role of citizen groups. They assembled the best information that they could, and made sure it was understood by the Fish and Game clubs. We were in touch all the time, but we used to get together, usually about this weekend every year, and we'd put together major briefs on the issues of the day. They provided technical input; we would provide the vehicle for delivering it. We would be the people who would turn up at public hearings, Water Board enquiries and that sort of thing, and I recall now being quizzed by those guys on our understanding of the facts. We were the guys who were going to have to stand up in front of the Controller of Water Rights. It was a good arrangement. There were no government grants; we were not being paid to be volunteers. I recall when we had to make presentations on the Columbia River Treaty in 1962, we just levied an extra membership charge on everybody belonging to the Regional Rod and Gun Club Association. We were not paid volunteers, getting any fancy grants from anybody. Fund raising meant digging into our pockets.

We tackled many issues then, but selected them for their precedent value. The Creston Valley Waterfowl Management Area has now become internationally famous. In the late 1950s, as the Columbia Treaty talks were getting serious, we knew that the only way we could have an influence on the way in which land use decisions were being made on the Creston Flats was to become members of the local diking district. That meant acquiring some land in the diked area. Hunters and anglers dug into their own pockets to buy a piece of land. Fish and Game Clubs documented the need to protect the area, and how it could compensate for losses through the Treaty plans to dam a major river valley. Then we went to work on the BC ministers of the day, along the lines of "Are you going to make us embarrass you by pointing out that private citizens are putting up the money to do what you are supposed to be doing?" It worked. That was the nice kind of front door lobbying I suppose, but it worked. There was a good liaison between the government staff people and ourselves, and the politicians of the time knew that it was going on. Politicians didn't oppose the relationship. They were not as uptight as provincial politicians are now, wanting to put gag orders on everybody, and all that sort of thing. It was a system that worked, and in spite of all the talk today about consultation, the results were as good as, or better than, today's. I doubt that we can ever return to that approach, but I think public groups can do a lot more about acting as strong independent public groups that expose poor government practices, and praise the good ones, rather than get simply co-opted into

being a part of them. The two approaches should complement one another. (As a sad reflection on all that, both the federal and provincial governments have virtually eliminated their support for the Creston Waterfowl area.)

The important thing was that the public groups understood where they fitted into the system. They took the best technical information they could from the people who generated it and made sure that they got it into the system in a way that only they could do it. They got it in there as citizens and voters; as people who could turn their arguments into political issues. It helped if the public group's view happened to coincide with the kind of advice that the politicians were getting from their own technical people. Fish and Game Clubs of the day were the only show in town then, and that was a real advantage. We didn't have to compete with a dozen other groups trying to get the same attention. Most important they were not an auxiliary for a government process, as so many groups seem to be today. We were "free standing outfits" with a sense of purpose and commitment to conservation. Neither were we ideologically driven outfits trying to impose our view at all costs - like so many of today's headline (and donation) seekers.

Moving on, I moved from the Kootenays back to the Lower Mainland, and got interested in some of the local rivers. I had a choice in the late 50s, when I was going back to UBC, and then in the mid-60s once I moved back to the Lower Mainland, of being able to go steelhead fishing before breakfast on half a dozen different rivers from my Richmond or Coquitlam home, and still be in time for work in the morning. When I was teaching in Delta, I could sneak in an hour on the Salmon River before work. It meant getting up early, but you could still catch wild steelhead in the Lower Mainland. The Coquitlam River was listed in Sports Afield as one of the ten top steelhead rivers on the continent in the late 1950s. A sobering thought. The Salmon River, where I ended up doing quite a bit of work later on, was a neat rural river system where I learned to catch river coho. Nearly 20 years later, when we were working on the Salmon River, that experience came in handy. The Brunette, which now of course you've heard about as a recovery effort, had a slaughter-house on it. One of my favourite slides when I was an anti-pollution evangelist, and I am not using slides tonight, was of that river running bright red. Lynn Creek, the Seymour, the Alouette - you name them - you could catch truly wild fish in them. They were all live vibrant streams but we didn't have a crystal ball to see what lay ahead. Our energies focused on the "big issues" elsewhere. How wrong we were! The first real recognition of what was being lost was on the Coquitlam, which is going through another round of attempts to solve decades of problems. Even with that sort of very growing awareness of urban issues it didn't register that much; it certainly didn't register beyond a few of us who lived right there. I guess the big attention getters were taking on BC Hydro over the Moran dam on the Fraser, and new dams on the Columbia and Peace. (Few noticed the Nechako and Alcan.)

The Stellako River log drive in 1967 was another precedent setter when DFO decided on a show-down over log driving on a major salmon river, and sent the entire habitat branch to deal with the issue - **all three of them** - Forbes Boyd, Tom Bird and Rob Elvidge. Jim Servizi, and Roger Goodlad from the Salmon Commission were there and the provincial government kept their end up. They put their entire Northern BC biological staff on it - Charlie Lyons. (In 1967, by the way, all of the professionals working on environmental issues in BC were far fewer than the folks in this room tonight.)

I was getting information for a CBC TV Debate on the issue - we'd made it a hot one. Ray Williston, BC Water Resources minister and I were to be interviewed by a guy who was then a very, very bright, capable, hard hitting reporter, called Doug Collins. He has done different things since, but he was the live-wire interviewer of the day. The show was called "The Seven O'clock Show", and I think that was the time Williston referred to me as "a burr under the saddle of progress". I laughed with him about it years later, when he said "You know, we never saw another river log drive after that."

From a fisheries perspective, government agencies and public groups concentrated on the larger systems (usually sockeye systems). We were looking at the parts of the Fraser that were bringing in sockeye and pinks millions at a time. We were not paying attention to the little streams that we could step across, where a few dozen returning coho was a good population. If we multiply that several thousand fold as all the maps that you have seen scattered around today are showing, those small streams add up. One of the big problems in dealing with urban habitat issues, I realize in hindsight, was that the "they" who we opposed were BC Hydro, Kaiser Coal, MacMillan Bloedel, you name it. When we get to urban development the **"they"** becomes **"we"** for a lot of us. Urban issues make us hold the mirror up and too many folks look the other way if they don't always like what they see. We are all a part of the demand for housing; I have four kids, and I've watched them go through all the hassles of getting into a decent house - a lot harder than it was for me in my day, and I really understand where they are coming from and some of the rationale for development. Housing is a real social need. I'm not becoming a pro-developer, but it's important to recognize that good lobbying always requires understanding the other point of view.

This unwillingness to see the close to home problems is still with us. Just a few days ago the remote Taku River got as much ink in a day as urban stream habitat in the Lower Mainland gets in a month. Just think, if some of the energy put into opposing Alcan could have been devoted to what we are talking about here. If we had put 5% of the effort on all the issues I've touched on directly into addressing the urban habitat issues, we might not be looking at the kind of depressing pictures we are hearing about here. I suspect that people still have a long way to go.

What was the scene during all that period - in the 1960s and 70s - for non-government organizations, who were hopefully going to do the lobbying? (NGOs should be the people who are going to carry the technical message we've heard here today.) In the 60s and early 70s there was a far more open political system. Back then we had BC legislative committees that really worked, and of course the trick to lobbying effectively with legislative committees was to make sure you knew more than they did before you went to the committee meeting. I recall there was a big fuss in eastern British Columbia, where I had lived, about strip mining for coal. A reporter from the Vancouver Sun had gone to Kentucky and had come back with some really interesting articles on the damage to the environment caused by strip mining. I was executive director of the BC Wildlife Federation and thought: we have to get involved in this as an organization. We had to call for, and get involved in, legislative committee hearings and get the best information first hand. I called the BC Guide Outfitters Association, to see if they could help me find somebody from the coal industry in Kentucky who comes up to BC to hunt or fish. Within a day I discovered that Ed Breathitt, the Governor of Kentucky, came to British Columbia regularly to hunt and fish with the then secretary of the outfitters association. Within a week I was in Kentucky being shown around the coal mining sites, meeting with legislators and being squired around by all the civil servants and mining officials familiar with the issues. It all paid off, and this again is what I think lobbying is all about - I turned up at legislative committee meetings and started trotting out photographs taken only a few weeks before (along with all kinds of horrendous name dropping). But of course that was the kind of environment in which that worked. The process in my view was every bit as good, and probably better than the endless consultative committees that we have today. I've touched on that already. There was a role, a really strong direct role, for the public groups to play in the political process. The processes were probably a lot less complicated - we didn't have all these fancy environmental impact statements, consensus seeking forums, and all the other process and requirements we have come up with since then. I'm not just being nostalgic in looking back into a simpler world. I'm just telling you the way it was and I'm certain there is much of that that we can re-invent and try and get back to. I'll take the consensus seeking approach more seriously when I see governments and politicians at every level getting elected and playing by those rules.

The saddest part about where we are today as seen from the viewpoint of a long time citizen's group activist is that back then we hadn't allowed ourselves to be co-opted into taking part in so many advisory processes. We were not being bought off with a weekend in a fancy hotel, a few dinners, and a chance to shake hands with the minister, while we were buying into what government wanted anyway. We knew how the system of checks and balances worked and the politicians of the day appreciated that. Today too many potential conservation advocates have been sucked into processes that reflect the practices of the government of the day - rather than the well being of resources that those folks are supposed to care about. Others stay right outside the processes, and set themselves up as self-appointed critics.

In the 1970s we began moving towards more formal consultative processes, and I'm convinced we have lost more than we have gained. We moved into funding where we started to pay volunteers, as in the early days of S.E.P., for example. Lots of projects were started but many of the people involved lacked the sort of "fire in the belly" needed to really drive a public citizen movement. Worse yet, a lot of the best people in the citizens organizations were diverted into becoming auxiliary bureaucrats, accountants, project managers, and having to manage the funds that were being put their way. Some really live people who could have been involved in the political process (which they and they alone could do), became managers of what really should have been government run programs.

This was all compounded by the most idiotic squabbles over turf as new groups were appearing on the scene. A lot of attention gets paid to the headline grabbing issue of the day - with little thought being given to the role of that issue in a long range approach that really focusses on precedent setting. This is too bad because there was a massive jump in awareness about the environment in the 1970s. Unfortunately, it didn't take long for those in the game for the long haul to realize that environmental awareness by governments and the public at large was even then tied to economic cycles. You would have an upsurge in interest, then you would have the "hard-hat revolution" kick in as environmental initiatives affected jobs, and you would see the good stuff being set back or certainly not being enforced the way it should be. Sound familiar? I suspect that towards the end of my talk I might touch on the current BC scene, where we are seeing that "hard-hat revolution" like nobody else has ever seen it on this planet before.

Some of the groups began to get ideologies tied into their arguments as conservation/environmental questions became more political. For the most part the environmental movement has been allied with the "left". I'm not offering a political judgement about that; I'm just observing that it is a fact of life and that is the way it is being perceived by a lot of people involved. On a more positive note, conservation did begin to discover the urban scene, although it was a bit late. We began to realize in the 80s that there were habitat problems in the Lower Fraser/East Coast of Vancouver Island. However, public groups were catching the major public attention through the Greenpeace and the Amchitka protests, and the animal rights protests about seal hunts on the East Coast. These actions were a continuation of looking at issues away from our back-yards, important though they may be.

This all brings us closer to today. Where are we now? I think the activist groups, the province-wide ones and even a lot of the small local groups, still haven't got a real handle on the urban concerns. When they do get a handle on them they see that they are either pretty damn complicated or they focus on a very small piece. One thing I discovered on the Salmon River during the late 70's and early 80's was that we were locked into a whole system of legislation and protected proprietary rights, so hopelessly out of date that you might conclude that "you are not going to get there from here". Of course the trick is to see how you can adapt those mechanisms to make them work for you as a start. We always tend to look for something new, some over-arching council and that sort of thing, before we start to see if the existing system can be made to work. I'm not a conservative old fuddy-duddy,

but I still believe that “if it ain't broke, don't fix it”, and too often we try to come up with new mechanisms when we haven't given the existing ones a chance.

What do we have now? We have a heavy technical focus - witness this conference. That's good; nothing wrong with it. We have all kinds of information, but what do we do with it? How do we use it? How do we get it into the decision making systems that determine the fate of habitat?

We have paid volunteers, and too much blurring of the volunteer role and the government official role. There has been far too much of that. We are busily training people to be amateur stream technicians - don't get me wrong, that's a good thing for people to be doing. But let’s not fool ourselves that that can be an end in itself. Half the people in this room have spent years trying to get this information that is now being gathered by local people as volunteers into the municipal planning process. Were you listened to? Now if municipal politicians aren't going to listen to people who are established as expert witnesses and so on, there is only one thing that will make those people listen to the same information that is being gathered by keen enthusiastic people who like being on the river. Those locals put the information into a decision making political context. The politicians may get the message that in delivering the information, the folks who deliver it have the ability to make it a political issue too. There is nothing wrong with politics at this level. It's the way it should be. Too often folks with technical and governmental backgrounds brand politics as a dirty word. I'm not suggesting partisan politics, but that we get all these various community groups and citizens groups to understand the process in just the same way that the Urban Development Institute understands the process.

In some work I did for the Department of Fisheries this last fall I was appalled at just how poorly most citizens groups understood the existing doors that are open for them to walk through in trying to protect habitat. There seems to be little middle ground between doing nothing and going to the barricades when habitat is threatened. In most cases city hall has a process where habitat concerns can get into the process. Where a process doesn't exist, start by trying to create one. Public groups are not looking at that anywhere near enough and it is where we need to concentrate more of our attention and get people thinking about that. We don't have to create a lot of new governance like watershed councils and the like as a start. People have enough government already. First we need to use what we have going for us right now. I liken all this to building a house. Sure, you go to the architects to get a plan to begin with, but the house, not the plan, is the reality. You have to know what the foundations are. You have to get the individual bricks, and the individual components in place. Those are your local groups, your local people being able to work through the local processes and from that an improved process can emerge. Joe Kambietz put it to me one day when he said “The biggest problem is that we've got too many people wanting to be generals, and not enough guys out in the trenches fighting the war.” And that is so true.

Another problem is that we have allowed our habitat agendas to be highjacked by people who have another motive - the NIMBY thing (not in my back yard). Sure we've got to team up with all of the people interested in watersheds, but too often we allow the Fisheries Act and other legislation to be taken over by people who only see wetlands etc. as a means of addressing their other agendas; they just don't want too many neighbours in their neighbourhood. Sure we can have alliances with those people, but when we tie ourselves too closely to them city council says, “That's that bunch of rabble rousers who say ‘stop the world I want to get off’”, and they won't listen to the very legitimate concerns that community groups can bring to bear on habitat stuff. As I said earlier, we need much more strategic awareness about how the decision making system really works, and I've already referred to the fact that we try to move too quickly to the big picture without paying attention to the building blocks, the local groups, and the existing processes.

Now I will wind up with a bit of a look at my crystal ball. We should all do that more often. First, in no order of priority, I have always found when you want to get people motivated and alive about something you need a crisis to focus them. The crisis that we could really focus on in the urban habitat area in the Georgia Basin is that we really are looking at the near extinction of a species, wild coho, and that should appeal directly to a big user group. We had the strongest sports fishing lobby I have ever seen focused on the federal government this last year. The BC Wildlife Federation, Sports Fishing Institute, Sports Fishing Advisory Board, made trips back and forth to Ottawa that finally got the Prime Minister's attention. What was their message? - that the big issue was catch limits for chinook salmon in the Queen Charlotte Islands (which account for less than 1% of our total sport fishing effort). That is what Ottawa thinks is the big deal, and they think that they have solved political problems associated with sports fishing in British Columbia by dealing with that one. A more genuine reality is that 75% of the angling effort in British Columbia takes place on coho stocks in the southern Straits of Georgia and Juan de Fuca. These wild fish depend on the Georgia Basin Streams that you have been talking about today. That's a reality, and we have to remind the sports fish lobbyist to get into the real world, now that they have got their internal issue solved for now. The commercial lodges will be happy that they will have people coming back and that's good, but let's hope they will now get on to the real long term conservation issue. Let's get priorities straight. Whether we will or not I don't know. I thought DFO was on the best track it's ever been on in dealing with an issue about ten years ago when they started the Coho Initiative, but it became totally derailed by the aboriginal fisheries strategy and things like that, and we have to get it back on track. Coho could be the icon for your urban habitat efforts. We are not talking about some obscure species of scientific value, but about a species that has traditionally been the backbone for a tidal sport fishery enjoyed each year by upwards of 300,000 Canadians.

Next we need to create a political science dimension in our approach to stewardship that's every bit as objective as biological science or any of the other technical aspects of a watershed. Our (your) existing streamkeeper approaches can teach volunteers to map a stream. You can teach them restoration techniques. But if any of that is to have any practical value in protecting habitat then we have to teach them the mechanisms at city hall that determine whether or not habitat is protected. How the development process works - a straight lesson in civics. Simple lessons like that should be front and centre in every Streamkeepers manual and every Streamkeepers program. That's where we should begin. What's the point otherwise? You are just teaching people to be mini-PhDs and imagine that something will happen at the end of it. Somebody has to use the information to make things happen; I think we have to give a lot of help there in how streamkeepers operate.

Next, we have got to recognize the reality of the housing demand. I don't think we have done enough yet to try and work with the development industry. If any of you get a chance, go to the Street of Dreams, on the Coquitlam Watershed, or any of these other fancy housing developments where you see 10 to 20 thousand dollars invested in a fancy electronic system to open your garage door from the kitchen, to tell you when the baby's crying, why the dog's barking and all that sort of thing. Presumably that's what the consumer wants. But with all these fancy doo-dads and electronics, what do the house builders advertise? They advertise a stream through property, country living, rural living, and all the things that depend on a natural attractive environment. Maybe home buyers could be given the chance to make the same kind of investment, probably less, in ensuring that living in an attractive natural setting remains a reality, not just advertizing hype. The Urban Development Institute will point out the cost. Yes, but isn't it time we put a cost on valuing the environment? Give people a choice. In order to live in the country by a salmon stream, there is an extra price involved, and let the buyers decide. We can't avoid the fact that even fish and fishing are not necessities of life like affordable shelter is. We may not like that but I'm sure we can give consumers a chance to pay for the environment they claim they want.

Now let's look at today in British Columbia (and I apologize to our Washington State friends). We have allowed an environmental movement to get too ideologically involved. We had citizen group leader after citizen group leader ready to line up with Mike Harcourt a couple of years back, when he was announcing all the neat things that were being done about the Forest Practices Code, about new parks, about new protected areas - remember them? Harcourt's heart and head were in the right place. It seemed to be the right thing for the time. A lot of us applauded it, because the moves were something we had been working at for years and came to be a reality - far too fast unfortunately. A faulty process that took us a century to get into wasn't going to be unravelled in three years by trying to create consensus. But still there was a lot of really good stuff that came out of the attempt.

In October Harcourt stepped down and his successor quickly went to work dismantling what Harcourt had achieved. When I urged those public group folks who supported Harcourt that they focus on what they were now losing, they told me, "Oh we're calling the Minister." Fine; I asked them: "What about calling the Vancouver Sun? What about calling the Province? What about getting on the radio lines and all that sort of thing?" "That's not our style", was the reply, and when you dig deeper as to why it's not their style, it's that too many groups are already committed to programs, promises, and funding, and you don't want to bite the hand that feeds you. If that sounds harsh it's intended to be harsh because I think the environment has been let down. Thank God for some of the more extreme groups, although I don't agree with a lot of what they claim and do. I had hoped for a loud public outcry from the groups associated with environmental stewardship when the BC government took the guts out of the Urban Habitat Program. Instead of a major protest we had some polite phone calls and a bunch of letters that were all rationalized away. When the conscience of the BC government on environmental matters got sidelined, when Jim Walker was let go - did we see much major public protest? Sure we saw a few good newspaper columns about it, but not much else that counted, and we are letting all that slide away; I think it's too bad. The BC Environment Ministry has lost all of its senior habitat and fisheries staff - not a good start for Glen Clark's new concern for fish. Not to worry - the spin doctors will take care of the fish. The urban based environmental heavies were bought off by a 12% protected area promise, playgrounds away from where they live - what about their backyards?

It was all heavy stuff for the public groups to get locked into the Harcourt program, but he got moved for ideological reasons within his own party, and unions got back in control - the hard hat revolution. I think conservationists need to be reminding this government that if Glen Clark really wants to do something for fish, instead of just beating up on the Feds, most of the habitat problems are right in his jurisdictional bailiwick. If Glen Clark really wants to do something good for fish, then we need a Water Act that really helps fish, we need a Municipal Act that helps fish, we need a highways construction practices codes that really does reflect the interest in fish - every single one of them are under provincial jurisdiction. Of course that doesn't play very well when you want to get NDP people elected in the next federal election. It doesn't play very well either when the federal Liberals want to get their people elected, so they will likely be trying to outdo one another.

One other thing that I think is really important is that as a result of the Pacific Fleet Rationalization Plan, the so called Mifflin Plan, we are seeing a lot of money put into restoration. Now that should be heartening to the people who are interested in restoration - whether it works or whether we've got professional capabilities to keep on top of it I don't know. (It's no substitute for protection.) But you are going to get a labour force, and that labour force will be around for awhile, I'm sure of it. We are going to see a new group of technicians emerging from unemployed fishermen. We are going to see it too coming from loggers who are unemployed. That's bad news for paid volunteers, but I find some good in that, because it might force the citizen groups to get back to their real role of being the policy advocates in the process of saving habitat and getting back to where they belong in city hall and in the corridors in Victoria as well as on the streams.

A final comment. I am working on a program that might pull some of this together - Community Greenways. I was sceptical about it at first, but I've come around to realizing that it is something that cuts across a lot of interests. Watching some of those slides this morning, I guess the one good thing about Greenways, if for no other reason, is that if you have some Greenways, you haven't blacktopped it all. That's a start. Greenways can be a combination of interests in trails, in habitat, in wildlife, in fish, in better planning and that sort of thing, that pulls a lot of people together. I think the public are mistrustful of the way in which governments are receiving their advice on fisheries and fish habitat matters. People are realizing that when you appoint leaders of the fishing industry, the Sport Fishing Lobby, and the senior First Nations spokesmen as the major advisors on Fisheries Policy, we are setting the foxes to watch the chicken coop. It's wearing pretty thin. Government is realizing this and I'm sure we are going to see much more room for this broader general public involvement in these sort of processes. And by that I don't mean just the Greenpeace's and the Sierra Clubs, although outfits like the Sierra Legal Defence Fund and Project Wild are doing a lot of good these days. But I think you are going to see more people who are just interested in habitat as a part of the liveability of their community, who will be playing a stronger role in a lot of the decisions on this. I think it is part of our job to make that happen. That's a rather low note to end on but I think it's getting back to roots, getting people to realize how the process works. It's about realizing that stewardship is a personal commitment, not something you pay someone else to do. That is where the kind of changes that Eric Bonham urged are going to have to happen. I won't be around to see it, but I hope my kids and grandkids will make it happen.

Thank you.

Discussion

Q: Do you think there is any hope that the present BC government will actually do something to really protect urban fish habitat?
A: There are several NDP members in this room, for example, who are talking about working on environment issues from the inside again. They have to make sure that Ken Georgetti and company are not the only people getting Glen Clark's ear. I think you are going to see some of that happening, but I also think that you are going to see people in the various environmental groups begin to realize that they are not getting what they hoped for. And I don't think we have seen the worst of it yet. I think we are going to see much more dismantling of things like the Forest Practices Code as we go along. The best chance for change will have to come from inside the N.D.P. With Jobs - Jobs - Jobs as the slogan, I can't be more hopeful than that.

Q: (P. Scales) You were mentioning one of your old lines, and I agree, that groups must get involved politically. I wonder though if it is not to the group's advantage to get credibility first, and then do the political route - which is going along with what you said, that the timing has to be right.
A: Yes, absolutely. I have said already, people want to run to the barricade too quickly; remember you once accused me of inciting people to run to the barricades when I came out to a meeting in your community. They do this before they bother to find out what alternatives there are to manning the barricades. Trying to make the system work is one way to get credibility - probably more so than being amateur biologists. If there isn't a good environmental advisory committee in the community, make sure one is set up. Make sure that the public becomes aware of the various planning, zoning and development approval processes, and the way they all work. That can be done most effectively at a local level. But groups need some political strategy on this, and we have to be careful, because we can't talk about these things too much in a goldfish bowl. The local groups should do their best to get the credibility. When they run into a brick wall they go to groups such as the T. Buck Suzuki

Foundation, The United Fisherman and Allied Workers, the Wildlife Federation, or the Sierra Legal Defence Fund, who know how to take on local and regional governments in court if necessary. What's missing is that we rarely get these groups working together with a common strategy. It isn't a question of jumping into partisan politics, although I think some have done that. Really it is a question of getting credibility through understanding how the system works. Credibility isn't simply being able to pile up the kind of information that Otto (Langer), Melody (Farrell), and other people in this room have had in their hip pockets for years. The trick is for public groups to show that they know how to use that information and how to plug it in to the political, planning, and decision making processes.

Q: (P. Scales) If you don't mind, I've got one more thing. Howard and I have had this little battle going on; I agree with most everything Howard says, but your enthusiasm can be like a grandparent who winds the kids up and then leaves. You did that to us with the Salmon River, and so I would just like to point that out to you. Your enthusiasm is great, but sometimes you get them all fired up and then you leave; then what do we do now?
A: A good point. For me it was a question of volunteer burnout. I found myself acting as an unofficial advisor to a dozen groups in the Lower Mainland and elsewhere on my own time. I had a wife retiring, I was moving to Vancouver Island, and I lost touch. I just took on too much. Which is why we have got to get a broader base of people involved. One problem that causes volunteer burnout is that you get people all excited and interested; they give of their time; then on top of that they have to pay the phone bills, the secretarial bills, the printing of the brochure and that sort of thing. That's when they begin to drop out. This perhaps is where government funds could best be spent - to keep these citizen groups alive as citizen groups.

Q: We are getting a new type of person moving into the Lower Mainland. Is this going to make problems worse beyond the actual numbers?
A: Well, I think we will all have to work on that one collectively, very quickly. I have to be careful I don't do a John Nightingale here, but we must explain our conservation ethic to the new ethnic groups that are coming into our country, to people from a totally different society. I'm not passing value judgements here, but people from other places may have a different attitude towards the environment. We have to woo them and bring them on board. One thing that I am finding is a lot of the newcomers are interested in fishing and sport fishing. This is one avenue open to them. Don't forget that some of our earlier population waves were people who left farms, but who were plugged into a natural environment. They understood what ecosystems were about - they lived on them. When those people came to the Lower Mainland, they at least understood something about nature. We are now getting a completely different demographic mix. How successful we are will depend on how much people with a passion for nature are prepared to put their energies into it, to make people believe that we have something worth saving in the Georgia Basin. Perhaps the Greenways program gives us a chance to get this broad message back out into communities all over the place, and hopefully we'll see more of that extension work being done through fisheries agencies and so on. Instead of just teaching people how to become bio-technicians, we'll teach the newcomers to become stream protectors and stream stewards in the truest sense of the word.

Q: Do you think any of the existing groups in the province - the Wildlife Federation, for example - could actually grow to become some sort of supporting structure for these efforts?
A: I hope so, though your example may not be the best. What we need to do though is to make sure that each of them understands their slightly different niche in the scheme of things. We have got to get them together. It's not going to be done through a government agency. We have to get the leaders of the groups together and say, “OK, Streamkeepers you do this well, keep on doing what you

do well; Wildlife Federation, you do what you do well; T. Buck Suzuki, you do what you do well, etc." We don't need to reinvent wheels; we need to try and get these groups of people together far more than we have done to date. Some sporadic efforts at it have been made. We've got cross memberships - we've got Fish and Game Clubs in Streamkeepers; we have Stewardship Groups in the Wildlife Federation; we've got overlaps with the Federation of Naturalists and so on. I think that the best way of tackling the question is to make a major effort at getting these people working together. Sure they'll say "We are talking to one another", but they are not talking to one another anywhere near as much as they should. There are still too many institutional egos; there are too many prima donnas; and there are too many people who say, "I want to see it done my way; I was here first and because you are not part of my organization, go away". We've got to cut through that kind of stuff, because the issues are too important. But the willingness and the leadership have to come from the groups themselves.

FIELD TRIP ITINERARY

FIELD TRIP ITINERARY

Tour Leaders:

1. Bruce Reid, Fisheries and Oceans Canada, Habitat Enhancement Branch, New Westminster, B.C.

2. Barry Chilibeck, Fisheries and Oceans Canada, Habitat Enhancement Branch, Vancouver, B.C.

Site 1. Oaklands Development, Burnaby

- An engineered wetland constructed in 1993/94 to handle stormwater runoff which flows into Deer Lake (Brunette River Watershed).
- Also a good example of urban redevelopment site (from institutional to high density residential) which maximized tree retention during construction.

Site 2. Noons Creek Hatchery, Port Moody

- A salmonid hatchery operated by volunteers from the Port Moody Ecological Society.
- The Society has been extremely active within the community in raising local awareness of urban streams. Society members will provide a brief tour of the hatchery, outline their activities related to stream stewardship in the community, and a recent stream restoration project on Noons Creek.

Site 3. Westwood Plateau Development, Coquitlam

- This is the largest residential development under construction in the Lower Mainland area, which began development in 1989; and is projected to take 10 years for completion.
- The development impacts four major salmonid supporting streams: Noons Creek, Scott Creek, Hoy Creek, and the Coquitlam River.
- We will drive through the development and highlight some of the mitigative measures employed, including sediment control, leavestrips, stormwater management and stream crossings.

Site 4. Oxbow Springs Salmon Habitat Restoration Project, Coquitlam

- We will visit the site of a recent salmon habitat restoration project located on a remnant oxbow/side channel of the Coquitlam River.
- Matt Foy (DFO, Resource Restoration Branch) will describe the technical aspects of the project and lead us on a tour of the site.

Site 5. Lougheed Connector Highway Project/Coquitlam River Setback Dykes, Port Coquitlam

- We will drive through the City of Port Coquitlam and across the Lougheed Connector Bridge project which crosses over the lower Coquitlam River. As we drive by, you can see off-channel rearing ponds and spawning riffles constructed as habitat compensation associated with this project.
- We will also be able to see the Coquitlam River setback dyke, which was completed in 1995.

Site 6. Drive across the Fraser Glen Wet Detention Pond, Surrey

- After crossing the Fraser River via the Port Mann Bridge, we will stop at the Fraser Glen wet pond located in the headwaters of the Serpentine River Watershed.
- This is an excellent example of an aesthetically pleasing, but functional, wet detention pond.

Site 7. King Creek Culvert Daylighting/Habitat Restoration Project, Surrey

- In 1992, the City of Surrey agreed to daylight an approximately 70m section of culvert within King Creek that was impassable to salmon, to compensate for habitat losses associated with a road widening project. King Creek is a tributary to Bear Creek, within the Serpentine River Watershed.
- We will stop and look as this is a good example of a stream restoration project located in a confined site (squeezed between residential housing and road), incorporating both spawning and rearing habitat.

Site 8. Burnaby Big Bend, Fraser Foreshore Habitat Restoration Project, Burnaby

- We will stop and look at this habitat restoration project constructed by DFO in partnership with the City of Burnaby and the North Fraser Harbour Commission located on the tidal portion of the Fraser River.
- Steve Macfarlane (DFO, Habitat and Enhancement Branch) will meet us at the site and provide a brief tour of the project.

Site 9. Fraser Lands/Tugboat Landing Development, Vancouver

- Located on the foreshore of the Fraser River, this is an example of an industrial site converted to high density residential, and park development, incorporating habitat compensation and habitat banking (tidal marsh construction).
- Steve Macfarlane (DFO, Habitat and Enhancement Branch) will lead us on a tour of this site.

APPENDIX A: SPEAKER BIOGRAPHIES

APPENDIX A SPEAKER BIOGRAPHIES

Robert B. Aldrich
Before serving as the Principal Watershed Steward for Snohomish County, Mr. Aldrich was a watershed specialist for the consulting firm of Kramer Chin & Mayo for four years. Prior to that, he was the Water Quality Specialist for the City of Mountlake Terrace. Mr. Aldrich's educational experiences include a masters degree from Washington State University in Forestry with a minor in Engineering. In addition, Mr. Aldrich spent one year at the University of Washington and the University of Idaho studying fisheries and hydrology.

Mark Angelo
Mark is currently head of B.C. Institute of Technology's (BCIT) Fish, Wildlife and Recreation Program. A noted outdoor leader, river conservationist, teacher and writer, Mark is past chair of the 120,000 member Outdoor Recreation Council, and the first recipient of the "10 year National River Conservation Award". Mark has authored more than 100 articles and editorials pertaining to river related issues and other environmental concerns. He is Chair of the B.C. Heritage Rivers Board, and founder of the B.C. Rivers Day, the largest event of its kind in Canada, attracting up to 30,000 participants throughout B.C.

Jim Bomford
Jim has been with the MoELP Fisheries Branch as Engineering Unit Head since 1982; prior to that he worked with a number of engineering consultants including a stint as provincial manager and engineer for Ducks Unlimited. The Engineering Unit (staff of two) provides fisheries engineering assistance to Ministry staff in Regional offices and Headquarters sections. With respect to urban streams, he has had more success paving them than saving them!

Andrew J. Castelle
Andy is a Certified Professional Soil Scientist and Professional Wetland Scientist who specializes in natural resource management in urban environments. He is a member of the ARCPACS National Soil Certifying Board, and was a member of the Washington Department of Ecology Shoreline Environmental Mitigation Banking Task Force. Andy is also an instructor in the University of Washington's Wetland Science and Management Certification Program. During his 16 years experience, his focus on soil-water-plant interaction has resulted in the publication of numerous papers. Examples include four papers on stream, riparian, and wetland buffer use and effectiveness. Current research or papers in progress involve lead mobility in soils, sediment removal from construction site runoff, low molecular weight organic acids in forest soils, and biometrics of a restored salt marsh.

Barry Chilibeck
Barry Chilibeck is an Environmental Engineer working is fish habitat protection and restoration related to urban, hydroelectric and forestry-related fields for the Department of Fisheries and Oceans Habitat and Enhancement Branch. His principle urban interests are hydrology, and development and implementation of best management practices for urban stream protection.

Melody Farrell
Melody Farrell is a habitat biologist with the Department of Fisheries and Oceans. Since joining the Department in 1983 she has worked in both Pacific Region and headquarters as a water quality biologist, a restoration biologist, major projects manager, policy and program advisor and most

recently as an urban habitat planner. Prior to joining the Department she taught biology at North Island College, and worked as an environmental consultant. In her present capacity she liaises with community groups, local governments and provincial agencies to change and improve development planning processes in order to better protect fish habitat in settlement areas. She has collaborated on and written several publications that focus on urban habitat protection mechanisms, issues and approaches.

Kurt L. Fresh
Kurt Fresh is a research scientist with the Washington Department of Fish and Wildlife. He received his training from the University of the Pacific (Bachelor Degree) and the University of Washington (Masters). Since graduating in 1978, he has worked as a fisheries professional, spending most of that time with WDFW. His research interests have focused primarily on the life history and ecology of juvenile Pacific salmon, especially during their estuarine period of life. Most recently he has been investigating ecological effects of exotic plant species invasions of estuarine habitats and studying reasons for the decline in populations of anadromous fish populations in the Lake Washington Watershed, especially the sockeye salmon population.

Robert R. Fuerstenberg
Mr. Fuerstenberg is a Sr. Ecologist with the King County Department of Natural Resources, working in the Water and Land Resources Division. His background is mainly marine and aquatic systems, lately focussed on rivers, streams and wetlands. For the last 10 years he has been examining the impact of urbanization on the ecology of streams in this area as an outgrowth of our watershed planning and management efforts. This effort involves hydrologists, geologists and other biologists in this division and at the University of Washington, as well.

Matthew Foy
Matthew Foy is a Restoration Biologist. He joined DFO SEP in 1980 and has been involved in restoration projects from Bear River on the Alaska border to Fishtrap Creek (a tributary of the Nooksack river in Washington State). Matt has been primarily involved in restoration projects in the Lower Mainland since 1988.

Julia Gardner
Julia is a Principal in Dovetail Consulting, Inc., a company that specializes in collaborative approaches to environmental planning, policy analysis, and decision-making. Dovetail prepared "Community Stewardship: A Guide to Establishing Your Own Group," in the Stewardship Series. Julia has been involved in several projects at the local level, including Partners in Protecting Aquatic and Riparian Environments, and recent forums to launch the Coquitlam Watershed Stewardship Initiative. She is currently researching ways that the Sensitive Ecosystem Inventory is likely to be applied on Southeastern Vancouver Island. Julia is a Research Associate at UBC's Sustainable Development Research Institute and a member of the World Conservation Union's (IUCN) Commission on Environmental Strategy and Planning.

Robert (Bob) Gunn
Robert (Bob) Gunn (Dipl. Technology, Fish, Wildlife & Recreation) has been actively involved in environmental education for over 10 years, including work as a Park Naturalist for BC Parks as a private contractor, providing marine education and natural history programs to tourists and high school students. An Assistant Instructor with BCIT's Fish, Wildlife & Recreation Program and Coordinator of the Burnaby Lake System Project, Bob is also involved in the Burnaby Streamkeepers Program and assists several other stewardship groups within Burnaby. Bob is currently a citizen

representative of the City of Burnaby's Environment and Waste Management Committee and a member of the GVRD's Brunette Basin Task Group and Stormwater Management Task Group.

Ken Hall
Ken Hall is a Professor at UBC Dept. of Civil Engineering and Westwater Research Unit, Institute for Resources and Environment. His area of expertise is Environmental Chemistry. Present research areas include source, fate, and impacts of toxic contaminants in the aquatic environment. He recently studied pulp mill pollutants and urban stormwater runoff.

Andy Haub
Andy has worked with the City of Olympia's Water Resources Program, Department of Public Works, for 7 years. Andy's work focusses on environmental planning and capital facilities. Andy has a background in natural resource management and civil engineering from the University of Washington. He is currently working on a marine shoreline enhancement project, a wetland enhancement project, and incorporation of public art into a regional stormwater treatment facility.

Chris Hilliar
Chris was born in the Comox Valley, on Vancouver Island. He has a long history with environmental agencies. In the mid 70s he worked for Water Survey of Canada installing water recording stations on many different rivers and streams throughout B.C. and Yukon. He went on from that to work for Atmospheric Environment Service running weather stations at Cape St. James in the Queen Charlottes and at Estevan Point on Vancouver Island's west coast. Finally, he joined the Department of Fisheries and Oceans in 1980 where he has stayed for the past 17 years. He continues to plan his escape from the Department but spent the remainder of his time working on stewardship and partnership initiatives primarily in the Comox Valley.

Thomas Holz
Mr. Holz has a Masters degree in Civil Engineering and over 20 years experience in water resources related project management, and performance of engineering studies, designs and construction. His experience ranges from hydrological studies and plans for entire basins to design projects. In recent years he has managed the stormwater program for Thurston County where he supervised the drafting of Thurston County, Lacey, Tumwater, and Olympia's drainage ordinance and the completion of four major basin plans. Basin plans focused on urbanization impacts on stream hydrology and mitigation measures to keep streams from being devastated by development.

Mr. Holz was the chair of the committee that presented the "Salmon in the City" conference in 1992. This conference explored habitat needs for urban streams and the influence of proposed regulations for detention on refuge habitat. Mr. Holz has had the honor of serving on review committees for Washington State Department of Transportation for their runoff water quality plan and for their drainage manual. He has also sat on committees reviewing the drafting of DOE's Stormwater Management Manual (The Technical Manual) and Stormwater Program Guidance Manual. He has also represented the American Public Works Association on a committee reviewing elements of the Puget Sound Water Quality Plan.

Louise R. Kulzer

Ms. Kulzer has been a water quality specialist for King County for the last four years. There she has managed the update of water quality facility designs for the King County Surface Water Design Manual. She also originated a flexible menu-driven approach for meeting specific water quality goals for different receiving water types. Before that she worked at the Municipality of Metropolitan Seattle, providing water quality and soil monitoring support for construction and design of wastewater treatment and transit projects. Ms. Kulzer has a degree in Systematics and Ecology from the University of Kansas and an MPA in Public Administration from the University of Washington.

Otto E. Langer

Otto has worked as a habitat protection and water quality biologist with Fisheries and Oceans and Environment Canada for 28 years. Much of his time has been spent on contaminants control, sediment impacts on salmonid streams and general fish habitat protection. As part of this work, he has been involved in many enforcement actions related to pollution and habitat destruction charges. During the past 6 years he has led a Fraser River Action Plan unit which has taken a lead to promote stewardship of urban streams in the Lower Fraser River Valley. He has a Masters degree in fisheries biology and has been president of the Association of Professional Biologists of B.C.

Gino Lucchetti

Gino Lucchetti is a Senior Ecologist with King County Department of Natural Resources. He received a BSc in Fisheries from the University of Washington and a MSc in Fish and Wildlife from Virginia Polytechnic Institute. With King County, Gino has been active in habitat planning, management, and research in urban and rural areas of Puget Sound. Gino has also worked for the Tualip Tribes, US Fish and Wildlife Service and US Forest Service.

Greg Mallette

Greg Mallette is the Lower Fraser Basin Regional Coordinator for the Fraser Basin Council (formerly Fraser Basin Management Program). He has been involved in a number of community based stewardship projects, both as a consultant to government and as a volunteer. His involvement has ranged from work on small scale rehabilitation and enhancement projects, to watershed and basin wide planning initiatives in both the Columbia and Fraser River systems.

Mike Miles

Mike Miles is a consulting fluvial geomorphologist working out of Victoria, B.C. He has 20 years experience undertaking fisheries mitigation, enhancement or restoration projects in western Canada. Mike has recently reviewed the physical success of a variety of instream enhancement projects in south western Alberta and B.C. He will be discussing the results of these studies and providing some insights into the implications of this work for urban stream restoration programs.

Howard Paish

Howard Paish was trained as an adult educator and teacher. Since his arrival in Canada over 40 years ago, Howard has immersed himself in advocacy for conservation issues. He has been active in non-governmental organizations, and has acted as director for about 15 different NGOs in Canada and internationally, many of them in the conservation sector. He has been active politically, has worked as a wilderness guide; and has a consulting company that addresses various resource issues in B.C. Howard makes his home on Vancouver Island and is currently working on a project to present the concept of Community Greenways throughout the province.

Ken Rood

Mr. Rood is a geomorphologist and hydrologist with a background in environmental assessment. He has extensive consulting experience in assessing the effects of water resources - and other - developments on the hydrology, hydraulics, sediment regime, and morphology of rivers. Mr. Rood has been a principal of Northwest Hydraulic Consultants since 1991 and his consulting experience is in British Columbia, Yukon and Northwest Territories. He currently manages Northwest's North Vancouver Office.

Pete Scales

Pete Scales serves Langley Township in the position of Environmental Project Manager with Engineering Division. Pete came to the Township in 1992 tasked with placing the municipality on a course of sustainability. In this regard, he was seconded for 80% of his time to work with community groups. Presently, he serves as Coordinator of the Salmon River Watershed Management Partnership, a multi-agency environmental service and training organization. His work involves reaching the public and motivating community groups to take a lead role in stream protection. He writes a weekly environmental article in the Langley Times. Pete is trained as a Marine Biologist and holds a Masters Degree in Agriculture. Before coming to the township he led his own successful environmental consulting and product development business. He is an inventor and author of two novels, Mark of the Raven and Phoenix File, both espionage thrillers.

Hans Schreier

Dr. Hans Schreier is a Professor with the Institute for Resources and Environment at the University of British Columbia (UBC). Dr. Schreier's research focus is watershed management, soil and water pollution, and land-water interactions. Current research projects are located in the lower Fraser Valley, the Sunshine Coast, Nepal and Ecuador. Projects in the Fraser Valley focus on urban and rural-urban fringe issues of watershed management.

Kelly Whiting, P.E.

Kelly has been Civil Engineer with King County for 7 years, involved in the implementation of the 1990 King County Surface Water Design Manual doing development review, and since 1992, involved in the update of those standards. As a Project Manager, he has been responsible for software development and training of the new KCRTS continuous hydrologic model. He is a graduate of the University of Washington with previous experience with the City of Ellensburg, U.S. Department of Energy, University of Washington and Central Washington University.

Susan Wilkins

Susan Wilkins is an environmental scientist with twenty years work experience with both the private and public sectors. She has an M.Sc. in geography and geology from McMaster University. Susan has worked for B.C. Hydro, Department of Fisheries and Oceans, Sigma Engineering Ltd. and most recently, Pottinger Gaherty Environmental Consultants Ltd. Her background in impact assessment, primarily of hydroelectric projects, is also being applied to other areas of environmental study. Her involvement in urban systems is relatively recent, as the co-ordinator of a multidisciplinary team of biologists, ecologists, physical scientists and planners, conducting assessment and restoration plans for urban developers.

APPENDIX B: LIST OF REFERENCES

APPENDIX B LIST OF REFERENCES

References listed below were provided by workshop participants.

List of References

Stewardship Series:

Access Near Aquatic Areas: A Guide to Sensitive Planning, Design and Management. 1997. Fisheries and Oceans Canada (Fraser River Action Plan) and B.C. Ministry of Environment, Lands and Parks.

Community Greenways: Linking Communities to Country, and People to Nature. 1996. Fisheries and Oceans Canada (Fraser River Action Plan) and B.C. Ministry of Environment, Lands and Parks.

Community Stewardship: A Guide to Establishing Your Own Group. 1995. Canadian Wildlife Service, Fisheries and Oceans (Fraser River Action Plan), Fraser Basin Management Program, Forest Renewal B.C.'s Watershed Restoration Program.

Stewardship Bylaws: A Guide for Local Government. 1997. Fisheries and Oceans Canada (Fraser River Action Plan), B.C. Ministry of Environment, Lands and Parks, B.C. Ministry of Municipal Affairs.

Stream Stewardship Guide for Planners and Developers. 1994. Fisheries and Oceans Canada (Fraser River Action Plan) and B.C. Ministry of Environment, Lands and Parks.

Stream Stewardship, A Guide for Planners and Developers - Module 8 Stream Fencing. 1994. Fisheries and Oceans Canada.

The Streamkeepers Handbook: A Practical Guide to Stream and Watershed Care. 1995. Environment Canada and Fisheries and Oceans Canada (Fraser River Action Plan); B.C. Ministry of Environment, Lands and Parks.

Urban Initiative Series:

Environmental Stewardship in the Municipal Act. 1996. Fisheries and Oceans Canada (Fraser River Action Plan). Prepared by Cheryl Webb.

Partners in Protecting Aquatic and Riparian Resources (PPARR) Initiative. 1994. Fisheries and Oceans Canada (Fraser River Action Plan) and B.C. Ministry of Environment, Lands and Parks.

Partners in Protecting Aquatic and Riparian Habitat by Local Governments: An Inventory of Measures Adopted in the Lower Fraser Valley. 1995. Fisheries and Oceans Canada (Fraser River Action Plan) and B.C. Ministry of Environment, Lands and Parks.

Protection of Aquatic and Riparian Habitat on Private Land: Evaluating the Effectiveness of Covenants in the City of Surrey, 1995. 1996. City of Surrey and Fisheries and Oceans Canada (Fraser River Action Plan).

Stream Stewardship and Urban Initiative Series documents listed above, and others, are available from the Fraser River Action Plan, Fisheries and Oceans Canada, Vancouver, B.C.; Fax (604) 666-0417

Other Publications (in alphabetical order by author)

Adams, Mark, Ian Whyte. 1990. *Fish Habitat Enhancement: A Manual for Freshwater, Estuarine and Marine Habitats.* DFO, 324 pp.

Armstrong, J.E. 1981. *Post-Vashon Wisconsin Glaciation, Fraser Lowland, British Columbia*. Geological Survey of Canada Bulletin 322. 34 pp.

Armstrong, J.E. 1984. *Environmental and engineering applications of the surficial geology of the Fraser Lowland, British Columbia*. Geological Survey of Canada Paper 83-23. 54 pp.

Barker, Bruce, 1988. *Presentation to APWA stormwater manager's committee*.

Barton, D.R., W.D. Taylor, and R.M. Biette. 1985. Dimensions of Riparian Buffer Strips Required to Maintain Trout Habitat in Southern Ontario Streams. *N. Am. J. Fish. Mang.* 5:364-378.

Bates, K. 1983. *Draft guidelines for policy development stormwater management in urbanized areas.* Habitat Management Division, Washington Department of Fisheries.

Beanlands, G.E. and P. N. Duinker. 1983. *An ecological framework for environmental impact assessment in Canada*. Institute for Resource and Environmental Studies, Dalhousie University and the Federal Environmental Assessment Review Office. 132pp.

Belt, G.H., J. O'Laughlin and T. Merrill. 1992. Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature. *Idaho Forest, Wildlife and Range Policy Analysis Group Rept. No. 8.* Univ. of Idaho, Moscow, Idaho.

Berka, C.S. and H. Schreier. 1996 Land Use - Surface Water Quality Relationships in the Sumas River Watershed, Abbotsford, B.C. Canadian Water Resources Association, *Proceedings of the Watershed Management Symposium*, Vancouver, B.C. October 22-25, 1996, pp.223-228.

Berry, Wendell. 1981. *The Gift of Good Land, Further Essays Cultural and Agricultural.* North Point Press.

Beschta, R.L. 1978. Long-term Patterns of Sediment Production Following Road Construction and Logging in the Oregon Coast Range. *Water Resour. Res*. 14:1011-1016.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream Temperature and Aquatic Habitat: Fisheries and Forestry Interactions. *In* Salo, E.O. and T.W. Cundy, eds. *Streamside Management: Forestry and Fishery Interactions*. University of Washington, Institute of Forest Resources, Contribution No. 57.

Beschta, R.L., W.S. Platts, J.B. Kauffman and M.R. Hill. In Press. *Artificial stream restoration - money well spent or an expensive failure? In* Proceedings of 10th International Stream Habitat Improvement Workshop, August 19-22, 1996 Corvallis Or. Oregon State University, Corvallis, OR. pp. 21-49.

Beyerlein, D., 1996. *Effective Impervious Area: The real Enemy*. Unpublished. Aquaterra Consultants, Everett, WA.

Bilby, R.E. and P.A. Bisson. 1992. Allochthonous versus Autochthonous Organic Matter Contributions to the Trophic Support of Fish Populations in Clear-cut and Old-Growth Forested Streams. *Can. J. Fish. Aquat. Sci*. 49:540-551.

Bingham, S.C., P.W. Westerman, M.R. Overcash. 1980. Effects of Grass Buffer Zone Length in Reducing the Pollution from Land Application Areas. *Trans. Am. Soc. Agri. Eng.* (ASAE) 23:330-342.

Bioengineering for Streamside Vegetation. Source - Watershed Restoration, Victoria.

Bolling. 1994. How to save a river - A handbook for citizen action. Island Press Washington D.C.

Booth, D.. 1992. Geomorphological impacts of urbanization. Presented at: *Salmon in the City Conference, 1992.*

Booth, D.B. 1991. Urbanization and the Natural Drainage System: Impacts, Solutions and Prognoses. *The Northwest Environmental Journal.* 7(1): 93-118.

Brazier, J.R. and G.W. Brown. 1973. *Buffer Strips for Stream Temperature Control. Research Paper no.15*. Forest Research Lab, Oregon State Univ., Corvallis, OR. 9 pp.

Brett, J.R. 1956. Some principals in the thermal requirements of fishes. *Quart. Rev. Biol*. 31(2):75-87.

Broderson, J. Morris. 1973. *Sizing Buffer Strips to Maintain Water Quality*. M.S. Thesis, University of Washington, Seattle.

Brown, E.R., (ed.). 1985. Riparian Zones and Freshwater Wetlands. *Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington, Part I - Chapter Narratives*. pp. 57-80.

Brown, G.W. 1969. Predicting temperatures of small streams. *Water Resource Res.* 5(1):68-75.

Brown, S. B. Wernick, W.A. Thompson, A. Kenney, W. Tamagi, K. Hall, and H. Schreier. 1996. Watershed Modelling using a GIS/Hyper-media Framework: A case study of Land Use - Water Quality Interactions in the Salmon River Watershed in Langley, B.C. Canadian Water Resources Association, *Proceedings of the Watershed Management Symposium*, Vancouver, B.C. October 22-25. 1996, pp. 229-233.

Burns, J.W. 1972. Some Effects of Logging and Associate Road Construction on Northern California Streams. *Transactions of the American Fisheries Society* 101:1-17.

Burroughs, E.R., and J.G. King. 1985. Surface Erosion Control on Roads in Granitic Soils. *In Proceedings: ASCE Committee on Watershed Management*. Denver, CO. pp. 183-190.

Canadian Environmental Assessment Agency. 1994. *The Canadian Environmental Assessment Act, Responsible Authorities Guide*. Minister of Supply and Services, Ottawa. 216 pp.

Cannings, Richard & Sydney. 1996. *British Columbia: A Natural History*. Greystone Books/Douglas & McIntyre, 310 pp

Castelle, A.J., AW Johnson, and C. Conolly, 1994. Wetland and stream buffer size requirements - a review. *J. of Environmental Quality*, Vol. 23, no. 5, September - October 1994.

Chapman, D.W. and E. Knudsen. 1980. Channelization and livestock impacts on salmonid habitat and biomass in western Washington. *Trans. Am. Fish. Soc*. 101:357-363.

Charbonneau, P. and K. Bennett. 1996. City of Surrey E-Team: Final Summary Report to B.C. Ministry of Environment, Lands and Parks.

Chilibeck, B. et al, 1992. *Land Development Guidelines for the Protection of Aquatic Habitat*. Department of Fisheries and Oceans and BC Ministry of Environment, Lands and Parks. 128ppp.

Chow, V.T., 1964. *Handbook of Applied Hydrology*, McGraw-Hill, New York.

Corbett, E.S. and J.A. Lynch. 1985. Management of Streamside Zones on Municipal Watersheds. pp. 187-190. *In* R. R. Johnson, C.D. Ziebell, D.R. Patton, P.F. Folliott, and R.H. Hamre (eds.),

Riparian Ecosystems and their Management: Reconciling Conflicting Uses. First North American Riparian Conference. April 16-18, 1985, Tucson, Arizona.

Coyne, M.S., R.L. Blevins, and R. Rhodes. 1994. Sediment and Fecal Bacteria Containment by Vegetative Filter Strips. *J. Soil Water Conserv*. (in review).

Culp, J.M. and R.W. Davies. 1983. *An Assessment of the Effects of Streambank Clear-Cutting on Macroinvertebrate Communities in a Managed Watershed*. Canadian Technical Report of Fisheries and Aquatic Sciences, No. 1208: 115 p. Dept. Fish. Oceans; Fisheries Res. Branch; Pacific Biological Station; Nanaimo, B. C.

Dagget, Dan. 1995. *Beyond The Rangeland Conflict, Toward a West That Works.* The Canyon Trust.

Darling, N., L. Stonecipher, D. Couch, and J. Thomas. 1982. *Buffer Strip Survival Survey*. Hoodsport Ranger District, Olympic National Forest.

Derry, Bill. *Impacts of increasing urbanization on Stream Corridor Ecology - 19 year study of watersheds in Puget Sound.*

Dillaha, T.A., R.B. Reneau, S. Mostaghimi, and D. Lee. 1989. Vegetative Filter Strips for Agricultural Nonpoint Source Pollution Control. Trans. *ASAE 32:513-519*.

Dillon Consulting Ltd. 1996. *City of Surrey Salmon Habitat Restoration Program: Final Summary Report.*

Douglas College Institute of Urban Ecology. 1996. *Environmental Information Systems: Learning How to Use On-Line Resources.* 85 pp.

Doyle, J.E. 1991. *A report on large woody debris management - Mt. Baker - Snoqualmie National Forest.* Mt. Baker - Snoqualmie National Forest, Pacific Northwest Region, Forest Service. U.S. Department of Agriculture.

Doyle, R.C., G.C. Stanton, and D.C. Wolf. 1977. *Effectiveness of Forest And Grass Buffer Strips in Improving the Water Quality of Manure Polluted Runoff*. American Society of Agricultural Engineers, Paper No. 77-2501.

Ducan, W.F.A. and M.A. Brusven. 1985. Energy dynamics of three low-order southeast Alaska streams: allochthonous processes. *J. Freshwater Ecology* 4:233-248.

Dunne, T., and L. Leopold. 1978. *Water in Environmental Planning*. W.H. Freeman and Co., New York.

Ellis, David. 1996. *Net Loss: The Salmon Net Cage Industry In BC*. The David Suzuki Foundation, 195 pp.

Endo, T., and T. Tsurata. 1969. *Effect of Trees' Roots upon the Shearing Strength of Soils*. pp. 167-179. Annu. Rep. Hokkaido Branch, Tokyo For. Exp. Stn. 18:168-179.

Erman, D.C. and D. Mahoney. 1983. *Recovery after logging with and without buffer strips in northern California.* Contribution No. 186. California Water Resources Center, Univ. of California, CA. 50 pp.

Erman, D.C., J.D. Newbold, and K.B. Roby. 1977. *Evaluation of Streamside Bufferstrips for Protecting Aquatic Organisms.* Technical Completion Report, Contribution #165, California Water Resources Center, University of California, Davis, CA.

Fifield, J.S., and M.V. Harding. 1994. *Practical Approaches for Effective Erosion and Sediment Control*. International Erosion Control Association, Steamboat Springs, CO.

Fisher, Ury and Patton. 1991. *Getting To Yes - Negotiating Agreement Without Giving In.* Penguin Books.

Fitch, L., M. Miles, J. O'Neil, R. Pattenden and G. Van Der Vinne. 1994. *Defining the variables that influence success of habitat structures in southwestern Alberta: a work in progress. In* Proceedings of 9th International Trout Stream Habitat Improvement Workshop, September 6-9, 1994, Calgary, AB. Trout Unlimited Canada, Calgary, AB.

Fore, L., J.R. Karr and R.W. Wisseman. 1996. Assessing invertebrate responses to human activities: evaluating alternative approaches. *J. North Am. Benthological Society*, 15 (2): 212-231.

Fore, L., J.R. Karr and R.W. Wisseman. 1996. Assessing invertebrate responses to human activities: evaluating alternative approaches. *J. North Am. Benthological Society*, 15(2):212-231.

Fraser River Estuary Management Program. 1996. *The Fraser River Estuary Environmental Quality Report*. Burnaby, B.C., 164 pp.

Frissell, Christopher A. and Richard K. Nawa. 1992. Incidence and causes of physical failure of artificial habitat structures in streams of western Oregon and Washington. *North American Journal of Fisheries Management* 12: 182-197.

Fuerstenberg, R. 1992. Urbanization, when do the fish survive? *Salmon in the City Conference, 1992*. Available from King County Surface Water Management Division.

Gallagher, J.L., and H.V. Kibbey. 1980. Marsh Plants as Vectors in Trace Metal Transport in Oregon Tidal Marshes. *Am. J. Bot*. 67:1069-1074.

Ghaffarzadeh, M., C.A. Robinson, and R.M. Cruse. 1992. Vegetative Filter Strip Effects on Sediment Deposition from Overland Flow. *In Agronomy Abstracts*. ASA, Madison, WI.

Gibb, Allan, B. Bennett and A. Birkbeck, 1991. *Urban runoff quality and treatment: a comprehensive review.* B.C. Research Corporation, Vancouver B.C. V6S 2L2

Gilliam, J.W. 1994. Riparian Wetlands and Water Quality. *J. Environ. Qual*. 23:896-900.

Glavin, Terry. 1996. *Dead Reckoning: Confronting the Crisis in Pacific Fisheries*.The David Suzuki Foundation/Greystone Books, 181 pp.

Grant, G.E., 1990. Hydrologic, geomorphic and aquatic habitat implications of old and new forestry. pp. 35-53 in A.F. Pearson and D.A. Challenger (eds.) *Forests - wild and managed: differences and consequences.* Faculty of Forestry, University of British Columbia, Vancouver, Canada.

Grant, G.E., F.J. Swanson, and M.J. Wolman. 1990. Pattern and origin of stepped bed morphology in high-gradient streams, western Cascades, Oregon. *Geographical Society of America Bulletin* 102:340-352.

Gregory, S.V. 1980. *Effects of light, nutrients, and grazing on periphyton communities in streams*. Ph.D. thesis. Oregon State University, Corvallis, OR. 151 pp.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An Ecosystem Perspective of Riparian Zones: Focus on Links Between Land and Water. *BioScience* 41:540-551.

Hall, K. and H. Schreier. 1997. Urbanization and Agricultural Intensification in the Lower Fraser Valley. Impacts on Water Use and Quality. *GEO Journal*. (in press, January 1997).

Hall, K.J., G.A. Larkin, R.H. MacDonald, and H. Schreier. 1996. Water Pollution from Urban Stormwater Runoff in the Brunette River Watershed, B.C. Canadian Water Resources Association, *Proceedings of the Watershed Management Symposium*, Vancouver, B.C. October 22-25, 1996, pp. 235-243.

Harding, Lee, Emily McCullum, eds. 1994. *Biodiversity in BC: Our Changing Environment.* EC/CWS, 426 pp.

Hartman, G.F. and M. Miles. 1995. *Evaluation of fish habitat projects in British Columbia and recommendations on the development of guidelines for future work.* Unpublished report prepared for Fisheries Branch, B.C. Ministry of Environment, Lands and Parks, Victoria, B.C.

Hartman. G. F., J. C. Scrivener, and M.J. Miles. 1996. Impacts of logging in Carnation Creek, a high-energy coastal stream in British Columbia and their implications for restoring fish habitat. Can. *J. of Fish. and Aq. Sci.* 53 : 237-251.

Hassett, J.J. and W.L. Banwart. 1992. *Soils and Their Environment*. Prentice Hall, Englewood Cliffs, NJ.

Henderson, J.E. 1986. Environmental Designs for Streambank Protection Projects. *Water Res. Bull.* 22:549-558.

Herricks, Edwin, ed. 1995. *Stormwater runoff and receiving systems: impact, monitoring and assessment.* CRC Press, Inc. 458 pages. ISBN 1-56670-159-7.

Hewlett, J.D., and J.C. Fortson. 1982. Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont. *Wat. Resour. Bull*. (AWRA) 18:983-988.

Hicks, B.J., J.D. Hall, PA Bisson, and J.R. Sedell, 1991. Responses of salmonids to habitat changes. *In Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats*, American Fisheries Society Special Publication 19, Meehan, WR, editor.

Higgs, D.A., J.S. McDonald, C.D. Levings, and B.S. Dosanjh. 1995. Nutrition and Feeding Habits in Relation to Life History Stage. *In* Groot, C., L. Margolis, and W.C. Clarke, eds. *Physiological Ecology of Pacific Salmon*. UBC Press, Vancouver, B.C. 510 pp.

Horner, R., J. Skupien, E. Livingston and H.E. Shaver, 1994. *Fundamentals of Urban Runoff Management: Technical and institutional issues.* Terrene Institute, Washington D.C. 20006 Phone: 202, 833-8317.

Horner, R.R, J.R. Karr, B.W. Mar, and E.B. Welch: Principal Investigators, J. Bryant, C. Cooper, J. Olthof, C. May and A. Wydzga; Graduate students, 1996. *The Cumulative Effects of Urbanization on Small Streams in the Puget Sound Region*. Abstract of research project presented at APWA Stormwater Managers Meeting, October 8, 1996.

Horner, R.R., and B.W. Mar. 1982. *Guide for Water Quality Impact Assessment of Highway Operations and Maintenance*. Washington Department of Transportation. Rpt. No. WA-RD-39.14. Olympia, WA.

Horter, Will et al. 1997. *Stream Protection Under 'The Code': The Destruction Continues*. Sierra Legal Defense Fund (SLDF), 42 pages. Avail. by Donation: $10 from: Sierra Legal Defence Fund, Suite 214-131 Water Street, Vancouver, BC V6B 4M3. tel: (604)685-5618, fax: (604)685-7813, e-mail: sldf@wimsey.com.

Hubbard, R.K., and R.R. Lowrance. 1992. Solute Transport Through a Riparian Forest Buffer System. *In Agronomy Abstracts*. ASA, Madison, WI.

Hume, Mark. 1992. *The Run of the River: Portraits of Eleven BC Rivers*. New Star Books, 215 pp.

Hunter, Chris. 1991. *Better Trout Habitat: A Guide to Stream Restoration and Management*. Montana Land Reliance, 319 pp.

Hynes, H.B.N. 1970. *The Ecology of Running Waters*. University of Toronto Press. 555 pp.

Jacobs, T.C. and J.W. Gilliam. 1985. Riparian Losses of Nitrate from Agricultural Drainage Waters. *J. Environ. Qual*. 14:472-478.

Johnson, A.W., and D. Ryba. 1992. *A Literature Review of Recommended Buffer Widths to Maintain Various Functions of Stream Riparian Areas*. King County Surface Water Management Division, Seattle, WA.

Johnson, A.W., and J.E. Caldwell, 1992. *Analysis of existing fish habitat in a portion of Woodland creek, Thurston County, Washington*. Found in Appendix H of Thurston County, 1995.

Jones. J. A. and G. E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. *Water Resource Research* 32(4): 959-974.

Jordan, T.E., D.L. Correll, and D.E. Weller. 1993. Nutrient Interception by a Riparian Forest Receiving Inputs from Adjacent Cropland. *J. Environ. Qual*. 22:467-473.

Kahn Z. et al., 1992. *Biofiltration swale performance, recommendations and design considerations.* Municipality of Metropolitan Seattle, currently King County, Dept. of Natural Resources, Seattle, WA 98104. Phone: 206, 684-1233.

Keller, Betty and Rosella Leslie. 1996. *Sea Silver: Inside BC's Salmon Farming Industry*. Horsdal & Schubart, 138 pp.

Kellerhals, R. and M.J. Miles. 1996. *Fluvial geomorphology and fish habitat: implications for river restoration. In* Proceedings of the Second IAHR Symposium on Habitat Hydraulics, Ecohydraulics 2000, June 1996, Quebec City, PQ. pp. A261-279.

Kleinfelder, D., S. Swanson, G. Norris, and W. Clary. 1992. Unconfined Compressive Strength of Some Streambank Soils with Herbaceous Roots. *Soil Sci. Soc. Am. J*. 56:1920-1025.

Koon, J. et.al. 1995. *Evaluation of Commercially Available Catch Basin Inserts for the Treatment of Stormwater*. Call - King County @ (206) 296-6519 for copy.

Koski, K.V. 1992. Restoring Stream Habitats Affected by Logging Activities. *In*: G.W. Thayer (ed.) *Restoring the National Marine Environment* [Chapt. 8]. A Maryland Sea Grant Book, College Park, Maryland.

Kulzer, L.R., 1989. *Considerations for the use of wet ponds for water quality enhancement*. Municipality of Metropolitan Seattle, currently King County Dept. of Natural Resources, Seattle, WA 98104. Available from King County, Water and Land Resources Division, (206) 296-8332. Price: $10.90.

Lantz, R.L. 1971. *Guidelines for Stream Protection in Logging Operations*. Oregon State Game Commission. Portland, Ore. 29 pp.

Leopold, Aldo. 1966. *A Sand County Almanac, (With Essays on Conservation) from Round River.* Oxford University Press, Inc.

Levy, David et al. 1996. *1996 Strait of Georgia Fisheries Sustainability Review*. Hatfield Consultants Ltd., 484 pp.

Lowrance, R., R.Todd, J. Fail, Jr., O. Hendrickson, Jr., R. Leonard, and L. Asmussen. 1984. Riparian Forests as Nutrient Filters in Agricultural Watersheds. *BioScience*. 34:374-377.

Lucchetti, G. and R. Fuerstenberg.1992. *Urbanization, habitat conditions and fish communities in small streams of western King County, Washington, USA with implications for management of wild coho salmon*. King County Surface Water Division, Seattle, Washington.

Lucchetti, G.L. and R.R. Fuerstenberg. 1992. Management of Coho Salmon Habitat in Urbanizing Landscapes of King County, Washington. Pages 308-317 in L. Berg and P.W. Delaney, editors. *Proceedings of the Coho Workshop*. Nanaimo, B.C., May 26-28, 1992.

Lynch, J.A., E.S. Corbett, and K. Mussallem. 1985. Best Management Practices for Controlling Non-point Source Pollution on Forested Watersheds. *J. Soil and Water Conservation* 40:164-167.

Madison, C.E., R.L. Blevins, W.W. Frye, and B.J. Barfield. 1992. Tillage and Grass Filter Strip Effects upon Sediment and Chemical Losses. *In Agronomy Abstracts*. ASA, Madison, WI.

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Farnklin, and J. Van Sickle. 1990. Source distances for coarse woody debris entering small stream in western Oregon and Washington. *Can. J. For. Res*. 20:326-330.

Meehan, W.R., F.J. Swanson, and J.R. Sedell. 1977. Influences of Riparian Vegetation on Aquatic Ecosystems with Particular Reference to Salmonid Fishes and Their Food Supply. USDA Forest Service General Technical Report MR-43. Contributed paper, *Symposium on the Importance, Preservation and Management of the Riparian Habitat*. July 9, 1977, Tucson Arizona.

Megahan, W.F., K.A. Seyedbagheri, T.L. Mosko, and G.L. Ketcheson. 1986. Construction Phase Sediment Budget for Forest Roads on Granitic Slopes. *In Proceedings: Drainage Basin Sediment Delivery*. IAHS Publication 159, Wallingfor, Oxon, U.K. pp. 31-39.

Megahan, W.F., N.F. Day, and T.M. Bliss. 1978. Landslide Occurrence in the Western and Central Northern Rocky Mountain Physiographic Province of Idaho; *In* C.T. Youngberg (ed.), *Proceedings: Forest Soil and Landuse*. Colorado State University, Fort Collins, CO. pp. 116-139.

Meggs, Geoff. 1990. *Salmon: The Decline of the BC Fishery*. Douglas & McIntyre, 265 pp.

MELP. 1996. *BC Water Quality Status Report*. 80 pp.

MELP/FRBC-WRP. 1995. *Coastal Fish Habitat Assessment and Rehabilitation Workshop*. November 6-9, 1995, 2 volumes, 300 pp. Available: Steelhead Society of BC, tel:(604) 931-8288, fax:(604) 931-5074, e-mail:<steelhd@unixg.ubc.ca>

Miles, M.J. In Press. *On the difficulty in restoring fisheries habitat in impacted gravel-bed rivers - case studies from the Coquihalla Highway and other areas of northwestern North America. In* Proceedings Gravel-Bed Rivers IV, Gravel-Bed Rivers in the Environment, August 20-26, 1995, Gold Bar, WA.

Millar, J., N. Page, M. Farrell, B. Chilibeck, and M. Child. 1997. *Establishing Fisheries Management and Reserve Zones in Settlement Areas of Coastal British Columbia*. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2351. Fisheris and Oceans Canada, 555 W. Hastings St., Vancouver, BC.

Minton, Gary, 1995. *Evaluation of commercially-available catch basin inserts for the treatment of stormwater runoff from developed sites*. The Catch Basin Insert Committee. Available from King County WA., Dept. of Natural Resources, Water and Land Resources Division, (206) 296-8332. Price: $10.90.

Murdock, A., and J.A. Capobianco. 1979. Effluent on a Natural Marsh. *J. Wat. Pollut. Control Feder.* 51:2243-2256.

Murphy, M.L. and K V. Koski. 1989. Input and Depletion of Woody Debris in Alaska Streams and Implications for Streamside Management. *N. Am. J. Fish. Mang.* 9:427-436.

Murphy, M.L. and W.R. Meehan. 1991. Stream Ecosystems. *In* Meehan, W.R., ed. *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*. American Fisheries Society Special Publication 19:17-46.

Murphy, M.L., and J.D. Hall. 1981. Varied effects of clear-cut logging on predators and their habitat in small streams of the Cascade Mountains, Oregon. *Can. J. Fish. Aquat. Sci*.38:137-145.

Murphy, M.L., C.P. Hawkins, and N.H. Anderson. 1981. Effects of canopy modification and accumulated sediment on stream communities. *Trans. Am. Fish. Soc*. 110:469-478.

Nadler & Hibino. 1994. *Breakthrough Thinking, The Seven Principles of Creative Problem Solving*. Prima Publishing.

Naiman, R.J., T.J. Beechie, L.E. Benda, D.R. Berg, P.A. Bisson, L.H. MacDonald, M.D. O'Connor, P.L. Olson, and E.A. Steel. 1992. Fundamental Elements of Ecologically Healthy Watersheds in the Pacific Northwest Coastal Ecoregion. *In* Naiman, R.J., ed. *Watershed Management. Balancing Sustainability and Environmental Change*. Springer-Verlag. New York, New York. 542 pp.

Naiman, Robert J., Editor. 1992. *Watershed Management.* Springer-Verlag, New York.

Newbury, Robert, Marc Gaboury. 1993. *Stream Analysis and Fish Habitat Design: A Field Manual*. Newbury Hydraulics Ltd., 262pp.

Northwest Hydraulic Consultants, Inc, 1990. A preliminary evaluation of hillslope hydrologic processes and implications for stormwater control in Thurston County. *In Drainage Design and Erosion Control Manual for Thurston County*, September 1991, Appendix I, Methodology for Arriving at Standard Release Rate.

Nowlan, Linda and Bill Jeffries. 1996. *Protecting BC's Wetlands: A Citizen's Guide*. West Coast Environmental Law Research Foundation and BC Wetlands Network.

Nowlan, Linda, ed. 1997. *Legal Options for Protecting Urban Streams - June 14, 1996 Workshop Proceedings*. West Coast Environmental Law Research Foundation, January, 110 pp.

O'Neil, J. and R. Pattenden. 1994. *Making sense of the numbers - evaluating the response of fish populations to habitat structures in southwestern Alberta (1987-1993). In* Proceedings of 9th International Trout Stream Habitat Improvement Workshop, September 6-9, 1994, Calgary, AB. Trout Unlimited Canada, Calgary, AB.

Omernik, J.M., A.R. Abernathy, and L.M. Male. 1981. Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships. *J. Soil Water Conservation* 36:227-231.

Overcash, M.R., S.C. Bingham, and P.W. Westerman. 1981. *Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites.* Transactions of the American Society of Agricultural Engineers (ASAE), pp. 430-435.

Packer, P.E. 1967. Criteria for Designing and Locating Logging Roads to Control Sediment. *Forest Science* 13:2-18.

Parry, B.L. and G.A. Seaman. 1994. *Restoration and enhancement of aquatic habitats in Alaska - case study reports, policy guidance, and recommendations*. Technical report No. 94-3. Alaska Department of Fish and Game, Juneau, AK.

Parry, B.L., C.M. Rozen and G.A. Seaman. 1993. *Restoration and enhancement of aquatic habitats in Alaska - project inventory, case study selection, and bibliography.* Technical Report No. 93-8. Alaska Department of Fish and Game, Juneau, AK.

Pattenden, R., M. Miles, L. Fitch, G. Hartman and R. Kellerhals. In Press. *Can Instream Structures Restore Fish Habitat. In* Proceedings: Forest Fish Conference 1996, Land Management Practices Affecting Aquatic Ecosystems, May 1-4, 1996, Calgary, AB. Trout Unlimited Canada.

Patton, D.R. 1973. *A literature review of timber harvesting effects on stream temperature*. Research Note RM-249. Rocky Mountain Forest and Range Exp. Sta. U.S. Forest Service. Fort Collins, Colorado.

Peterjohn, W.T., and D.L. Correll. 1984. Nutrient Dynamics in an Agricultural Watershed: Observations on the Role of a Riparian Forest. *Ecology* 65:1466-1475.

Pinkerton, Evelyn, Martin Weinstein. 1995. *Fisheries That Work: Sustainability Through Community Based Management.* The David Suzuki Foundation. 199 pp.

Pitt, D.G., W.G. Gould, and L. LaSota. 1986. *Landscape Design to Reduce Surface Water Pollution in Residential Areas*. Water Resources Information Bulletin No. 5. Univ. of Maryland. Cooperative Extension Service. 10 p.

Pitt, Robert, S. Clark and K. Parmer, 1994. *Potential groundwater contamination from intentional and nonintentional stormwater infiltration.* U.S. Environmental Protection Agency, Cincinnati, Ohio 45268. EPA/600/R-94/051.

Pottinger Gaherty Environmental Consultants Ltd. 1996. *Environmental Assessment of the proposed Suter Brook development, Port Moody, BC*. Report prepared for Greystone Properties Ltd. 25 pp + appendices.

R.L.& L. Environmental Services Ltd. 1993. *Instream Habitat Structure Audit 1992 Summary Report.* Unpublished report prepared for Alberta Environmental Protection, southern Alberta Region, Lethbridge, AB.

R.L.& L. Environmental Services Ltd. and M. Miles and Associates Ltd. 1996. *Post-flood status of instream habitat structures in southwestern Alberta.* Unpublished report prepared for Alberta Environmental protection, Southern Region, Lethbridge AB.

R.L.& L. Environmental Services Ltd., M. Miles and Associates Ltd. and the Alberta Research Council. 1994. *Analyses of the performance of stream habitat structures in southwestern Alberta-data report.* Unpublished report prepared for Department of Fisheries and Oceans, Sustainable Fisheries Program, Winnipeg, MB.

Reiser, D.W. and T.C. Bjornn. 1979. *Habitat Requirements of Anadromous Salmonids*. USDA Forest Service. Pacific Northwest Forest and Range Experiment Station. General Technical Report PNW-96.

Richards, K.S. 1977. Channel and Flow Geometry: A geomorphological Perspective. *Prog. Phys. Geogr*. 1:66-102.

Robinson, G.E. and R.L. Beschta. 1990. Identifying trees in riparian areas that can provide coarse woody debris to streams. *Forest Science* 36:790-801.

Roby, K.B., D.C. Erman, and J.D. Newbold. 1977. *Biological Assessment of Timber Management Activity Impacts and Buffer Strip Effectiveness on National Forest Streams of Northern California*. USDA - Forest Service, California Region.

Rood, K. and R. Hamilton. 1994. Hydrology and water use for salmon streams in the Fraser Delta HMA. B.C. *Can. Man. Rep. of Fish. and Aq. Sci*. No. 2238.

Rosgen, D. 1996. *Applied River Morphology: A Guide for the Classification, Assessment...* Wildland Ecology, Pagosa Springs, Colorado.

Sale, Kirkpatrick. 1991. *Dweller in the Land - The Bioregional Vision.* New Society Publishers.

Savory, Allan. 1988. *Holistic Resource Management*. Island Press, Washington D.C.

Schellinger, G.R., and J.C. Clausen. 1992. Vegetative Filter Treatment of Dairy Barnyard Runoff in Cold Regions. *J. Environ. Qual.* 21:40-45.

Schueler, T.R. 1996. *Crafting Better Urban Watershed Protection Plans*. Watershed Protection Techniques, vol 2, #2. p. 329 - 337.

Sedell, J.R. and R.L. Beschta. 1991. Bringing back the "Bio" in Bioengineering. *American Fish. Soc. Symposium* 10: 160-175.

Shisler, J.K., R.A. Jordan, and R.N. Wargo 1987. *Coastal Wetland Buffer Delineation.* New Jersey Dept. of Environmental Protection, Division of Coastal Resources, Trenton, New Jersey. 102 pp.

Sigma Engineering Ltd. 1994. *Land Development Guidelines: Discussion Paper on Leave Strips*. Draft report for Department of Fisheries and Oceans. 29 pp. + appendices.

Slaney, Tim et al. 1996. *Status of Anadromous Salmon & Trout in BC & Yukon*. *Journal of Fisheries*, Volume 21, # 10, October, pp.20-35.

Sonntag, N.C. et al. 1987. *Cumulative Effects Assessment: A context for further research and development*. Report for Canadian Environmental Assessment Research Council, Ottawa, 91 pp.

Steedman, R.J. 1988. Modification and assessment of an index of biotic integrity to quantify stream quality in southern Ontario. *Canadian Journal of Fisheries and Aquatic Sciences*. 45: 492-501.

Steelquist, R., David Gordon & Assoc. *Educating for Action - More Success Stories from Puget Sound.* Puget Sound Water Quality Authority, Olympia, WA.

Steinblums, I., H. Froehlich, and J. Lyons. 1984. *Designing Stable Buffer Strips for Stream Protection.* U.S. Forest Service, 2520 Watershed Protection and Management.

Stormwater Pollution Control Manual, 1996. King County, WA Dept. of Natural Resources, Water and Land Resources Division, 206, 296-8332. Price: $12.63. (Business practices & source control BMPs).

Surface Water Design Manual, Proposed Feb. 1996 update. King County, WA Dept. of Natural Resources, Water and Land Resources Division, 206, 296-8332. Price: $35.00.

Swift, L.W. Jr. and S.E. Baker. 1973. *Lower Water Temperatures within a Streamside Buffer Strip.* U.S. Department of Agriculture, Forest Service Research Note SE-193. S.E. Forestry Experimental Station, Asheville, NC. 7 pp.

Thorne, C.R., and N.K. Tovey. 1981. Stability of Composite River Banks. *Earth Surf. Processes Landforms* 6:469-484.

Thurston County, 1995. *Woodland and Woodard Creek Comprehensive Basin Plan*, Thurston County, Storm and Surface Water Program, Washington.

Trout Unlimited. *Better Trout Habitat*.

U.S.Environmental Protection Agency, 1988. *Results of the Nationwide Urban Runoff Program, Volume I*. Water Planning Division, Washington D.C. 20460. NTIS Accession no. PB84-185552.

Uthank, A. 1994. *Summary of initial results of tabulations for stream project structures placed on the Willamette National Forest between 1986 and 1993*. Unpublished draft document, Mt. Willamette NF. Pacific Northwest Region, Forest Service. U.S. Department of Agriculture. WA.

Vanderholm, D.H., and E.C. Dickey. 1978. *ASAE Paper No. 78-2570*. ASAE Winter Meeting, Chicago, IL.

Waldron, L.J., and S. Dakession, 1982. Effect of Grass, Legume, and Tree Roots on Soil Shearing Resistance. *Soil Sci. Soc. Am. J*. 46:894-899.

Walters, Carl. 1995. *Fish on the Line:The Future of Pacific Fisheries*. The David Suzuki Foundation, 82 pp.

Washington Dept. of Ecology (WDOE). *Restoring Wetlands in Washington*

Watershed Protection Techniques. *A quarterly bulletin on Urban Watershed Restoration and Protection Tools*. Center for Watershed Protection, Silver Spring, MD 20910, phone: 301, 589-8745. Tom Schueler, editor.

Wolman, M.G. and A. Schick. 1967. Effects of construction on fluvial sediment, urban and suburban areas of Maryland. *Water Resources Research* 3(2): 451-464.

Wolman, M.G. and A. Schick. 1967. Effects Of Construction On Fluvial Sediment, Urban And Suburban Areas Of Maryland. *Water Resources Research* 3(2): 451-464.

Wong, S.L., and R.H. McCuen. 1982. *The Design of Vegetative Buffer Strips for Runoff and Sediment Control*. A Technical Paper Developed as part of a Study of Stormwater Management in Coastal Areas Funded by Maryland Coastal Zone Management Program. 23 pp.

Wray, W.K. 1986. *Measuring Engineering Properties of Soil*. Prentice Hall, Englewood Cliffs, NJ.

Xu, L., J.W. Gilliam, and R.B. Daniels. 1992. Nitrate Movement and Loss in Riparian Buffer Areas. *In Agronomy Abstracts*. ASA, Madison, WI.

Young, R.A., T. Huntrods, and W. Anderson. 1980. Effectiveness of Vegetated Buffer Strips in Controlling Pollution from Feedlot Runoff. *J Environ. Qual*. 9:483-497.

Zimmerman, R.C., J.C. Goodlett, and G.H. Comer. 1967. The Influence of Vegetation on Channel Form of Small Streams. Symposium on River Morphology. *Int. Assoc. Sci. Hydrol.* 75:255-275.

APPENDIX C: LIST OF WORKSHOP SPEAKERS AND PARTICIPANTS

LAST	FIRST	ORGANIZATION	Branch	TEL	FAX	Street	City	e-mail
Chilibeck	Barry	Fisheries and Oceans Canada	Regional Headquarters	604-666-3765	604-666-7907	Stn 327, 555 W. Hastings St.	Vancouver, BC V6B 5G3	chilibeckb@VANHQ1-AM.PAC.DFO.CA
Clark	Brian	Ministry of Environment, Lands and Parks	Planning and Assessment	604-582-5300	604-660-8926	10334 - 152A St.	Surrey, BC V3R 7P8	BClark@surrey.env.gov.bc.ca
Clarkson	Bruce	City of Surrey	Engineering Department	604-591-4326	604-591-8693	14245 56th Ave.	Surrey, BC V3X 3A2	
Coulter-Boisvert	Maurice	Fisheries and Oceans Canada	Community Advisor	604-666-2870	604-666-7112	610 Derwent Way, Annacis Island	New Westminster, BC V3M 5P8	boisvert@mailhost.pac.dfo.ca
Davies	Ross	Alouette River Management Society		604-467-0747	604-467-0747	23924 Fern Cres.	Maple Ridge , BC V2X 7E7	jjarvis@direct.ca
Davis	Alison	Simon Fraser University	Resource Management	604-986-0242	604-291-4968	2936 Princess Ave.	North Vancouver, BC	ajd@sfu.ca
Delaney	Peter	Fisheries and Oceans Canada	Habitat Management	604-666-2410	604-666-7907	555 W. Hastings St.	Vancouver, BC	
Douglas	Leslie	Township of Langley		604-533-6079	604-533-6098	4914 - 221 Street	Langley, BC V3A 3Z8	
Duncan	Lorna	Coast River Environmental Services		604-264-7522	604-264-7600	1672 W. 75th Ave.	Vancouver, BC V6P 6G2	criver@direct.ca
Eliasen	Richard	Fisheries and Oceans Canada	South Coast Division	604-756-7278	604-756-7162	3225 Stephenson Point Rd.	Nanaimo, BC V9T 1K3	eliasenr@am.scdnan.pbs.dfo.ca
Farrell	Melody	Fisheries and Oceans Canada	Fraser River Action Plan	604-666-4609	604-666-0417	1220, 555 W. Hastings St.	Vancouver, BC V6B 5G3	
Foy	Matt	Fisheries and Oceans Canada	Resource Restoration Division	604-666-3678	604-666-0292	Stn. 321 - 555 W. Hastings St.	Vancouver, BC V6B 5G3	foym@MAILHOST.PAC.DFO.CA
Fresh	Kurt	Washington State Dept. of Fish and Wildlife		360-902-2756	360-902-2980	600 Capital Way North	Olympia, WA 98501-1091 USA	FRESHKLF@dfw.wa.gov
Fuerstenberg	Bob	King County	Department of Natural Resources	206-296-8364	206-296-0192	700 Fifth Ave, Suite 2200	Seattle, WA 98104 USA	robert.fuerstenberg@metrokc.gov
Gardner	Julia	Dovetail Consulting		604-878-1148	604-737-2607	105 - 2590 Granville St.	Vancouver, BC V6H 3H1	jgardner@unixg.ubc.ca
Gidora	Sam	Fisheries and Oceans Canada	Community Advisor	604-666-6325; Cell: 328-7121	604-666-7112	4500 Capilano Park Rd.	North Vancouver, BC	gidoras@mailhost.pac.dfo.ca
Gunn	Bob	BC Institute of Technology	Fish, Wildlife and Recreation	604-451-6860	604-432-9046	3700 Willingdon	Burnaby, BC V5G 3H2	rgunn@bcit.bc.ca
Hall	Dr. Ken	University of British Columbia	Westwater Research Centre	604-822-6474	604-822-5357	1933 West Mall	Vancouver, BC V6T 1Z3	
Harlow	Cindy	Fisheries and Oceans Canada	Duncan Office	250-748-0278	250-746-8397	Box 241, 230 Underwood St.	Duncan, BC V9L 3X3	
Harvey	Linda	Regional District of Comox-Strathcona		250-334-6000	250-334-4358	4795 Headquarters Rd, P.O. Box 3370	Courtenay, BC V9N 5N5	
Haub	Andy	City of Olympia	Public Works	360-753-8475	360-753-8087	900 Plum St. SE, PO Box	Olympia, WA	

LAST	FIRST	ORGANIZATION	Branch	TEL	FAX	Street	City	e-mail
			Department			1967	98507	
Henigman	Maggie	Ministry of Environment, Lands and Parks	Habitat Protection	250-751-3214	250-751-3103	2080-A Labieux Rd.	Nanaimo, BC V9T 6J9	
Hietkamp	Fern	Fisheries and Oceans Canada	Fraser River Action Plan	604-666-2044	604-666-0417	1220, 555 W. Hastings St.	Vancouver, BC V6B 5G3	hietkampf@mailhost.pac.dfo.ca
Hilliar	Chris	Fisheries and Oceans Canada		250-339-1361	250-339-4612	148 Port Augusta St.	Comox, BC V9M 3N6	hilliarc@mars.ark.com
Hollingshead	Eva	Ministry of Environment, Lands and Parks	FRBC Coordinator	250-751-3256	250-751-3103	2080 - A Labieux Rd.	Nanaimo, BC	
Holz	Tom	SCA Engineers Inc		360-493-6002	360-493-2476	677 Woodland Square Loop SE	Lacey, WA 98503 USA	passca@mail.tss.net
Howie	Rick	Ministry of Environment, Lands and Parks	Habitat Protection	250-371-6245	250-828-4000	1259 Dalhousie Dr.	Kamloops, BC V2C 5Z5	rhowie@kamloops.env.gov.bc.ca
Hughes	Deb	Fisheries and Oceans Canada	Squamish Area Office	604-892-2040	604-892-2378	Box 2360	Squamish, BC V0N 3G0	
Huntington	Vicki	Corporation of Delta	Councillor	604-940-0454	604-940-9139	102 - 4815 48th Ave.	Delta, BC	
Hurley	Karen	District of Saanich		250-475-1775	250-475-5450	770 Vernon Ave.	Victoria, BC	
Husted	Lynn	Forest Renewal BC	Program Manager	250-356-2095	250-356-2227	9th Fl, 727 Fisgard St.	Victoria, BC V8V 1X4	ldhusted@hq.frbc.gov.bc.ca
Hutton	Karen	Fisheries and Oceans Canada	Water Quality	604-666-0845	604-666-6627	610 Derwent Way, Annacis Island	New Westminster, BC V3M 5P8	huttonk@mailhost.pac.dfo.ca
Hwang	Jason	Fisheries and Oceans Canada	Prince George Area Office	250-561-5396	250-561-5534	3690 Massey Drive	Prince George, BC V2N 3N5	hwangj@mailhost.pac.dfo.ca
Jensen	Allen	City of Port Coquitlam		604-944-5411	604-944-5407	2580 Shaughnessy St.	Port Coquitlam, BC V3C 2A8	
Jex	Bill	Ministry of Environment, Lands and Parks	Habitat Protection	604-582-5260	604-660-8926	10334 - 152A St.	Surrey, BC V3R 7P8	bajex@surrey.env.gov.bc.ca
Johnson	Mark	Fisheries and Oceans Canada	Community Advisor	666-0743; Cell:290-3156	604-666-7112	610 Derwent Way, Annacis Island	New Westminster, BC V3M 5P8	
Kaatz	Pamela	Ministry of Environment, Lands and Parks	Fisheries Section	604-582-5353	604-660-8926	10334 152A St.	Surrey, BC V3R 7P8	pgkaatz@surrey.gov.env.bc.ca
Knight	Rob	Ministry of Environment, Lands and Parks	Urban Salmon Habitat Program	604-582-5200	604-660-8926	10334 - 152A St.	Surrey, BC V3R 7P8	RKNIGHT@surrey.env.gov.bc.ca
Kulzer	Louise	King County	Dept. of Natural Resources	206-296-1980	206-296-0192	700 5th Ave., Suite 2200	Seattle, WA 98104 USA	louise.kulzer@metrokc.gov
Ladd	Mike	Ministry of Environment, Lands and Parks	Habitat Protection	250-490-8252	250-492-1314	201 - 3547 Skaha Lake Rd.	Penticton, BC V2A 7K2	mladd@penticton.env.gov.bc.ca
Lane	David	T. Buck Suzuki Environmental Foundation		604-255-8819	604-255-3162	160 - 111 Victoria Dr.	Vancouver, BC V5L 4C4	bucksuzuki@ufawu.org
Langer	Otto	Fisheries and Oceans Canada	Fraser River Action Plan	604-666-8171	604-666-0417	1220, 555 W. Hastings St.	Vancouver, BC V6B 5G3	
Lee	Deanna	Ministry of Environment,	Habitat Protection	604-582-5266	604-582-5335	10334 - 152A St.	Surrey, BC V3R	dllee@surrey.env.gov.bc.ca

LAST	FIRST	ORGANIZATION	Branch	TEL	FAX	Street	City	e-mail
		Lands and Parks					7P8	
Letay	Sylvia	Ministry of Environment, Lands and Parks	Habitat Protection	604-795-8433	604-792-3947	9365 Mill St.	Chilliwack, BC V2P 4N3	sletay@galaxy.gov.bc.ca
Lucchetti	Gino	King County	Dept. of Natural Resources	206-296-8366	206-296-0192	700 5th Ave., Suite 2200	Seattle, WA 98104 USA	gino.lucchetti@metrokc.gov
Magnan	Al	City of Nanaimo	Development Services	250-755-4409	250-755-4439	455 Wallace St.	Nanaimo, BC V9R 5J6	amagnan@city.nanaimo.bc.ca
Mallette	Greg	Fraser Basin Council		604-660-0439	604-660-3600	P.O. Box 10086, Suite 2970, 700 W. Georgia St.	Vancouver, BC V7Y 1B6	Greg_Mallette@fraserbasin.bc.ca
McBain	Grant	Fisheries and Oceans Canada	Community Advisor	604-883-2613	604-883-2152	Box 10, RR#1 Field Site C61	Sechelt, BC V0N 3A0	
McCuaig	Bill	District of West Vancouver	Community Forester	604-925-7143	604-925-7140	3755 Cypress Bowl Rd.	West Vancouver, BC V7S 3E7	
McPhee	Mike	Quadra Planning Consultants Ltd.		604-944-6917	604-944-6701	1030 Crestline Rd.	West Vancouver, BC V7S 2E2	mcphee_quadra@compuserve.com
Michalski	Tracy	Ministry of Environment, Lands and Parks	Urban Salmon Habitat Program	250-751-3100	250-751-3103	2080-A Labieux Rd.	Nanaimo, BC V9T 6J9	
Miles	Mike	M. Miles and Associates		250-595-0653	250-595-7367	645 Island Road	Victoria, BC V8S 2T7	mmaa@coastnet.com
Milne	Karen			604-990-9218	604-984-8638	710 West 17th St.	North Vancouver, BC V7M 1W2	
Mitchell	Wendy							
Munro	Karen	Munro Environmental Consulting		604-988-4072	604-988-0213	5271 Malaspina Pl	North Vancouver, BC V7R 4L9	
Naito	Gerry	Summit Environmental Consultants Ltd.		250-545-3672	250-545-3654	17A - 100 Kalamalka Lake Rd.	Vernon, BC V1T 7M3	secl@junction.net
Nanson	Dave	Fisheries and Oceans Canada	Fraser River Division	604-666-0514	604-666-6627	610 Derwent Way, Annacis Island	New Westminster, BC V3M 5P8	
Page	Nick	Coast River Environmental Services		604-264-7522	604-264-7599	1672 W. 75th Ave.	Vancouver, BC V6P 6G2	criver@direct.ca
Paish	Howard	Howard Paish and Associates		250-468-7999	250-468-7929	P.O. Box 30 RR1 Beachcomber	Nanoose Bay, BC V0R 2R0	
Payette	Krista	Ministry of Environment, Lands and Parks	Urban Salmon Habitat Program	604-582-5200	604-660-8926	10334 - 152A St.	Surrey, BC V3R 7P8	KMPayett@surrey.env.gov.bc.ca
Ptolemy	Ron	Ministry of Environment, Lands and Parks	Conservation Section	250-356-7054	250-387-9750	2nd Floor, 780 Blanshard St.	Victoria, BC V8V 1X4	ptolemys@pacificcoast.net
Reid	Bruce	Fisheries and Oceans Canada	Fraser River Division	604-666-0514	604-666-6627	610 Derwent Way, Annacis Island	New Westminster, BC V3M 5P8	
Robinson	Janine	Quadra Planning Consultants Ltd.		604-945-3622	604-945-3622	2-2880 Dacre Ave.	Coquitlam, BC V3C 4H6	jrobinsn@deepcove.com
Romaine	Mike	Fisheries and Oceans Canada		604-666-3856	604-666-0417	1220 - 555 W. Hastings St.	Vancouver, BC V6B 5G3	romainem@mailhost.pac.dfo.ca

LAST	FIRST	ORGANIZATION	Branch	TEL	FAX	Street	City	e-mail
Rood	Ken	Northwest Hydraulic Consultants Ltd.		604-980-6011	604-980-9264	2 - 40 Gostick Place	North Vancouver, BC V7M 3G2	krood@nhc-van.com
Rueggeberg	Harriet	City of Nanaimo	Strategic Planning Division	250-755-4483	250-755-4403	455 Wallace St.	Nanaimo, BC V9R 5J6	hrueggeb@city.nanaimo.bc.ca
Scales	Pete	Township of Langley	Environmental Manager	604-533-6136	604-533-6098	4914 - 221 Street	Langley, BC V3A 3Z8	
Schaefer	Val	Douglas College	Institute of Urban Ecology	604-527-5224	604-527-5095	PO Box 2503	New Westminster, BC V3L 5B2	val_schaefer@douglas.bc.ca
Schreier	Dr. Hans	University of British Columbia	Inst. for Res. and Env't	604-822-4401	604-822-9250	2206 East Mall	Vancouver, BC V6T 1Z3	star@unixg.ubc.ca
Sherlock	Catherine			604-929-6558	604-929-7757	27 - 3839 Indian River Dr.	North Vancouver, BC V7G 2P5	
Shields	Brian	City of Coquitlam	Engineering Department	604-933-6114	604-933-6301	2647 Austin Ave.	Coquitlam, BC V3K 3S2	
Simpson	Rick			604-937-5300	604-937-5300	1786 View Street	Port Moody, BC V3H 3Y2	RLSimpson@mindlink.net
Smailes	Angela	Coquitlam River Watershed Action Committee		604-980-5130	604-980-5130	462 E. 11th St	North Vancouver, BC V7L 282	asmailes@sfu.ca
Stalberg	Heather	Fisheries and Oceans Canada	Kamloops Area Office	250-851-4950	250-851-4951	1278 Dalhousie St.	Kamloops, BC V2C 6G3	
Stoddard	Erin	Ministry of Environment, Lands and Parks	Urban Salmon Habitat Program	604-582-5374	604-660-8926	10334 - 152A St.	Surrey, BC V3R 7P8	EMStodda@surrey.env.gov.bc.ca
Summers	John	Ministry of Environment, Lands and Parks	Habitat Protection	604-582-5239	604-660-8927	10334 - 152A St.	Surrey, BC V3R 7P8	JDSummers@surrey.env.gov.bc.ca
Swift	Doug	Fisheries and Oceans Canada	Campbell River Office	250-287-2146	250-286-0034	Rm. 215 - 940 Alder St.	Campbell River, BC V9W 2P8	
Truelson	Bob	Ministry of Environment, Lands and Parks	Water Quality Branch	250-387-9492	250-356-8298	765 Broughton St., 3rd Floor	Victoria, BC V8V 1X6	BTRUELS@epdiv1.env.gov.bc.ca
von Schuckmann	Sylvia	Ministry of Environment, Lands & Parks				2nd Floor, 780 Blanshard St.	Victoria, BC V8V 1X4	
Voysey	Frank	Fisheries and Oceans Canada	Campbell River Office	250-287-2103	250-286-0034	Rm. 215 - 940 Alder St.	Campbell River, BC V9W 2P8	
Wellman	Sarah	Fisheries and Oceans Canada	Habitat and Enhancement	604-666-3014	604-666-8874	Stn 349 - 555 W. Hastings St.	Vancouver, BC V6B 5G3	pattersons@am.vanhq4.pac.dfo.ca
Whiting	Kelly	King County	Water and Land Resources	206-296-8327	206-296-0192	700 5th Ave., Suite 2200	Seattle, WA 98104 USA	kelly.whiting@metrokc.gov
Wilkins	Susan	Pottinger Gaherty Environmental Consultants		604-895-7621	604-682-3497	1100 - 1130 West Pender	Vancouver, BC V6E 4A4	pgl@mindlink.bc.ca
Winfield	Nick	Fisheries and Oceans Canada	Habitat Management	604-666-0129	604-666-7907	327 - 555 W. Hastings St.	Vancouver, BC V6B 5G3	nicholaw@unixg.ubc.ca
Zahynacz	Igor	City of Port Coquitlam	City Engineer	604-944-5411	604-944-5407	2580 Shaughnessy St.	Port Coquitlam, BC	
Zandbergen	Paul	University of British Columbia	Inst. for Res. and Env't	604-822-6224	604-822-3250	436E - 2206 East Mall	Vancouver, BC V6G 1Y2	pzand@unixg.ubc.ca