Action Plan for the Restoration and Stewardship of Abel Creek, District of Invermere

March 2006

Prepared by: Osprey Communications and Carolla Environmental Consulting

Prepared for: District of Invermere with funding from the Habitat Conservation Trust Fund of BC

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March 2006

Executive Summary

The District of Invermere (DOI) has taken the initiative to make and act on a plan to protect Abel Creek. Abel Creek originates in the Paddy Ryan Lakes, the source of DOI municipal water supply. This creek flows along the southern boundary of the town and is one of five major creeks that flow into Lake Windermere. In this dry region, a creek the size of Abel provides precious and unique habitat diversity for wildlife and fish, including a population of kokanee in its lower reach. A continuing trend of increased development in the DOI places further demand on the Paddy Ryan Lakes for water supply and requires an action plan to maintain water quality and quantity. The DOI recognizes both its responsibility towards and opportunities arising from the restoration and stewardship of Abel Creek.

The total length of Abel Creek is approximately four kilometers. For over half of its length the creek is flowing 'ditch-like' beside roads located within one side of its riparian zone and several meters or less from its aquatic zone. There are numerous culverts under roads and adjacent driveways along the length of Abel Creek that create impacts and loss of habitat. Impact mitigation options are limited in some sections by the gullied terrain. There are operational challenges for road maintenance whilst striving to maintain the ecological integrity of the creek.

The long term vision for Abel Creek is to protect and restore its function as a healthy riparian stream ecosystem through restoration and stewardship and to make it part of a greenways network for the community.

A short term restoration and stewardship plan includes the following actions, in priority sequence:

1) Create an Abel Creek Working Group to address immediate restoration needs and to follow through with the recommended phases of the Abel Creek Action Plan.
2) Conduct an engineering/ fluvial study of the roadways adjacent to reach 1 and 2 of Abel Creek to identify specific opportunities for short and long term solutions to restoring the creek.
3) Conduct water quality and flow monitoring in Abel Creek and watershed.
4) Conduct a fish inventory and habitat assessment in Abel Creek and watershed.
5) Increase education efforts regarding water consumption and maintaining stream health, and make an interpretive plan for a greenways network along Abel Creek.

A long-term restoration and stewardship plan includes the following actions:

1) De-activation of lower Johnson road in Reach 2 near Westside Road intersection
2) Removing/replacing selected culverts with bridges or with bottomless arch culverts
3) De-activation of lower Sandwell Road
4) Initiate stream restoration initiative in other important streams to Windermere Lake, in particular Goldie Creek.

1.0) Background

Between 2000 and 2001 the DOI developed a Lake Windermere Management Strategy that focused on the overall health of the lake. Among other outcomes, the study recommended water quality monitoring, an environmental inventory of the lake, as well as the establishment of a community group. As Abel Creek is one of the sources of inflow to Lake Windermere, continued protection of Abel Creek was identified as being closely linked to the health of Lake Windermere.

In November 2002, the DOI adopted the Abel Creek Protection Strategy that forwarded a resolution to develop a management and restoration plan for Abel Creek. Abel Creek is recognized in the DOI Official Community Plan (OCP) as a watercourse to be protected.

In the fall of 2004, the DOI submitted a proposal to the Habitat Conservation Trust Fund for fisheries and wildlife inventory, mapping, data collection and to develop a restoration plan under the HCTF's strategic objective of "increasing understanding and respect for ecological values, promotion of responsible behavior towards and familiarity with nature and build public support for habitat-based ecological values in the Province." The proposal was submitted with a budget of $90,000.

In response to this proposal HCTF awarded DOI with funding of $5000 to develop a more comprehensive plan concentrating on stewardship aspects starting with the collection of inventory information. This information would be used to develop a management plan for the stream and determine any restoration works that need to be done. The HCTF also recommended using the SHIM (Sensitive Habitat Inventory Mapping) methodology developed in part by the Department of Fisheries and Oceans as a cost effect approach to the project.

In the fall of 2005 Osprey Communications was contracted by the DOI to fulfill the following objectives with the Abel Creek Protection Plan funding from HCTF.

2.0) Objectives

The purpose of this report is to document and synthesize the information gathered on Abel Creek and to formulate an action plan. This background information and subsequent action plan is to inform DOI mayor, council and staff, community groups and landowners, and for submission to potential funding partners.

The preliminary information gathered for this report as described in the SHIM methodology includes:

1) Collection, review and summary of existing information.
2) Direct communication with local experts.
3) Gathering of maps and photographic records.

This was accomplished by:

- landowner interviews by phone and site visits to discuss history and present concerns about Abel Creek
- water license review
- literature search and review
- overview field assessment
- meetings with DOI planners and staff and Provincial Ministry personnel

The main objectives of the Abel Creek Action Plan are to:

1) Define and recommend the geographic scope of the action plan that will best serve the desired outcomes of the restoration goals;
2) Describe feasible short and long-term strategies for stream stewardship and restoration;
3) Provide direction, priorities, and a phased project outline complete with estimated costs and suggestions for partners and funding sources.

3.0) Project Scope

3.1) Options for project scope

Based on a preliminary field assessment, Abel Creek can be divided into three reaches (**Appendix #1**). Reach #1 starts at Lake Windermere, and runs parallel to Sandwell Road upstream as far as the twin culverts under Westside Rd. Reach #2 extends from Westside Road upstream parallel with Johnson Road to the start of beaver dams and ponds near the Grizzly Ridge property line. Reach #3 extends from the beaver dams and ponds meandering through currently undeveloped private property upstream to the Paddy Ryan Lakes. All of Reach #1 and most of Reach #2 are within the municipal boundaries of the DOI. Reach #3 is under the jurisdiction of the Regional District of East Kootenay.

Rationale for increasing the scope of the restoration and stewardship action plan to include the entire watershed (Abel Creek, Paddy Ryan Lakes, Goldie Creek) includes the following points:

- Restoration and stewardship projects can be costly and time-consuming and will not be successful if they do not address issues upstream.
- Reach #3 flows within the extensive development proposal of Grizzly Ridge Properties and may be included in a municipal boundary extension if development proceeds
- The DOI has a vested interest in the health of the watershed as the source of its drinking water.

3.2) Summary of existing mapping

An inventory of available maps was made as part of this study. Field assessment and map production was beyond the scope of this phase. A topographic map (1:20,000 scale)

included in this report provides an overview of Abel Creek and the watershed. **(Appendix 1)** A cadastral map showing the accurate location of Abel Creek in relation to property boundaries within the DOI boundaries was not readily available. A legally surveyed map can be costly to produce. (Kathleen Wilker, Focus Engineering Ltd) SHIM outlines a cost effective GPS method.

Air photos ordered for the project provide variable scale historical information that gives a general picture of the land development in the area over time. No air photos were located that pre-date the construction of Sandwell and Johnson Roads. Focus Engineering Ltd. and Parks Canada were consulted for available map layers. The next phase of this project should include the creation of a comprehensive map to a scale of 1:5000 for planning and public consultations. The map should include stream location, property boundaries, and road, driveway and culvert locations.

4.0) Abel Creek Habitat and Existing Impacts

4.1) Description of physical stream characteristics

Abel Creek (Watershed Code 300-976900) originates at the Paddy Ryan Lakes, and is approximately 4km in length. The main tributary that flows in to the Paddy Ryan Lakes is Goldie Creek.

Reach 1 from Windermere Lake to Westside Road (approximately 1 km in length) is dominated by moderately steep gradient, with mainly riffle/ glide habitat, over small bed substrates (90% gravels and cobbles) (Griffith, 1994). The channel is uniform and ditch-like, and is adjacent to Sandwell Road over the length of the reach.

The second reach of Abel Creek extends from Westside Road to beaver dams/ponds just over 2 km upstream. The gradient is moderately steep and swift riffle habitat predominates. The ditch-like characteristic of the stream continues and this channelization has been worsened by the proximity of Johnson Rd.

Reach 3 extends from the start of the beaver dams/ponds to the Paddy Ryan Lakes, and is under 2 km long. There is a beaver lodge in the first large beaver pond that is close to Johnston Road, located in a small natural wetlands portion of the creek. There was no recent sign of activity in and around the beaver dams when inspected in November and December of 2005. No recently felled or chewed trees were observed. The ponds provide significant water storage and regulating function, which is especially important during low summer flows.

A list of fish confirmed in the Abel Creek watershed is presented in Table 1. Fish confirmed in reaches 1 and 2 of Abel Creek through fish sampling and observations, include Kokanee salmon, rainbow and brook trout (Griffith, 1994, FISS Ministry of Environment data base).

Kokanee enter the creek from Windermere Lake to spawn in the lower part of Reach 1. They enter the creek through the culvert under the railway, entering a short meandering section of good spawning habitat and undisturbed riparian vegetation before reaching a second culvert

under a driveway (Askey's P.1448). At this point the road and creek begin their 2.4 km interaction and the gradient and stream velocity also increases due to the gullied terrain. Despite this the kokanee do get through the second culvert and have been observed as far upstream as 0.5km where there is a natural barrier of a 1-2 metre falls near a driveway (lower Cope's house P.6674 3). There is a second 2.0m falls by the Harmsworth property (P.6674 2)

Rainbow trout and brook trout have been confirmed during electro-fishing conducted in the 1994 Griffith study. During the field assessments in preparation of this action plan, three six-inch brook trout were observed in reach 2 of Abel Creek. (just above Oglestone's bridge). The Ministry of Environment FISS web site indicated that according to the Resource Assessment Branch (RAB), Mountain whitefish utilize Abel Creek. There may be more species that utilize the stream that have not been documented.

The Paddy Ryan Lakes that feed Abel Creek are 4.25 ha in size, with a maximum depth of 8.5m, and a mean depth of 2m. According to MOE data records, the Paddy Ryan Lakes contain red side shiner, Westslope Cutthroat trout, Rainbow trout, and Brook trout.

The Paddy Ryan Lakes were treated with rotenone in 1957 in order to kill off coarse (non-sport) fish species (MOE website). There was periodic stocking of Westslope (Yellowstone) cutthroat, eastern brook trout and rainbow trout between the years 1938 to 1961 (FISS report B.C. government website).

Table 1. Life histories of fish thought to be present in Abel Creek and Paddy Ryan Lakes

Species	Stream/Lake utilization	Spawning timing	Incubation period to emergence	Comments
Kokanee	Confirmed. Fall spawning to emergence, observed upstream to Copes driveway	Sept-Oct	Oct-May	Fry migrate d/s after hatching; likely rear in Kinbasket Reservoir to maturity
Brook trout	Confirmed. Observed as far upstream as Reach 2 of Abel Creek	Mid Oct.-early Nov	2.5-3.5 months-emerge Jan-Feb	Introduced species from eastern N. America; historically stocked in Paddy Ryan Lakes
Rainbow trout	Confirmed in Reach 2 of Abel Creek	Spring (mid to late May)	4-6 week incubation; emerge July	Can hybridize with westslope cutthroat
Mountain whitefish	RAB information from gov't web site, not confirmed by sampling	Oct-Dec	Hatch in early spring	Do not build redds; lay eggs on surface of substrate Suspect that they would utilize lower part of reach 1; seasonal access from Windermere lake only

Red side Shiner	Confirmed in Paddy Ryan Lakes	Spring to summer (May to early August)		Commonly spawn in groups of 30-40
Westslope Cutthroat Trout	Historically stocked in Paddy Ryan Lakes (Yellowstone)	spring	Emerge late June to early July	Reduced range through Rockies; do not compete well with Brook Trout, red listed species

Sources: Griffith, 1994, Mayhood, D.W., 1995, Living Landscapes, Royal B.C. Museum

Riparian habitat is intact only on one side for reach #1, limited on both sides in reach #2 and mostly intact in reach #3. The consequences of inadequate riparian buffer include lack of shade cover in the summer months (which would result in higher than normal water temperatures), reduced supply of organic material, such as leaf drop, falling into the creek, and inadequate vegetated buffer to absorb pollutants and sediment from road run-off before they enter the stream. Higher stream temperatures and reduced supply or organic material to streams can lead to reduced biodiversity in species ranging from aquatic invertebrates, and fish. Other animals rely on riparian habitat such as birds, small mammals, and amphibians. Riparian habitats provide aesthetic and recreation values.

Road crews dealing with backed up culverts in winter are concerned that willows by the aquatic zone of the creek are contributing to this problem. Willows can be aggressive colonizers of riparian areas and can cause changes in the stream flow. At the same time this reduction in stream flow can be beneficial to the stream and the roots can act as bank stabilizers. In a creek that has an overall picture of compromised or absent riparian vegetation and siltation from road activities, clearing the willows is not recommended until there has been careful consideration of riparian vegetation composition and roles.

4.2) Description and location of main impacts

The main causes of impacts to Abel Creek are the result of the proximity of Sandwell and Johnson Roads to the stream channel for over half of the total stream length. Road proximity has made the stream channel more confined or channelized, and has resulted in a reduced riparian habitat. There are frequent culverts along the length of Abel Creek particularly in reaches 1 and 2 for both road and driveway crossings.

Seasonal run-off from the roadway has the potential to negatively impact the water quality of Abel Creek, which in turn can affect all aquatic life in the stream, from invertebrate abundance and diversity, to survival and reproduction of amphibians, and fish. Salt and sand are applied in the winter, and during spring thaw can create siltation of Abel Creek to Windermere Lake. Heavy rainfall will also cause increased sedimentation from road run-off. The other risk factor of the road proximity to the creek is vehicles accidentally ending up in the stream.

There are numerous small and several long culverts in Abel Creek. The combination of culvert length, diameter, and in some cases, angle in relation to the stream slope, have

created potential fish barriers at peak flows (velocity barriers). The main culverts that are potential problems in terms of fish passage are; the culvert at the Askey driveway (first driveway upstream from the confluence with Windermere Lake), the twin metal culverts at Westside Road, and one or more of the three metal culverts on Johnson Road in reach 2. **Table 2** provides a description and location of the main, potentially fish-barrier culverts in Reaches 1 and 2.

Some culverts flood *every* year like the one at the Cope's driveway below Westside Rd because the road and stream are close to the same level and a small amount of ice build up causes the flood. This causes salt and silt from the road to be washed in downstream.

Culverts represent a net loss in useable habitat and can be a barrier to fish migration in the stream. Aquatic life does not thrive in culverts, particularly in the round corrugated metal culverts that are found throughout Abel Creek.

In a steep part of reach #1 two small falls may be a barrier to fish movement. The final barrier to fish movement upstream in Abel Creek at its' source is an open concrete flume and a larger falls.

The District of Invermere is responsible for the year round maintenance of Sandwell Rd. and has just taken on the winter maintenance of Johnston Rd from the Ministry of Transportation and Highways. This gives the DOI a monetary incentive to find solutions to the interaction between roads and Abel Creek while at the same time protecting the creek.

It is the responsibility of the landowners to construct and maintain crossing structures in the creek to access their homes. Rather than culverts some landowners have put in bridges at the encouragement of Ministry of Environment staff. A cost sharing agreement could be arranged with the Ministry of Environment if funds could be found and designated to support landowners in maintaining or upgrading more ecologically 'friendly' structures. (Peter Holmes, pers comm., Feb 2006)

Table 2. Location and Description of culverts in Reach 1 and 2 of Abel Creek

Culvert #	Location	Type	Diameter	Length	Comments
1	At CPR line at Windermere Lake	Round corrugated			Can become blocked with debris/ beavers may periodically block inlet
2	Askey Driveway Reach 1	concrete	700mm	Estimated at 5 m	Narrow culvert in an area of Kokanee migration in Abel Creek
3	Cope Driveway	Round corrugated			Culvert and stream bed are close in elevation to road; stream frequently floods road at this location when culvert ices in winter
4	At Westside Road Reach 1/2	Twin round corrugated metal			Likely fish barrier at high flows

TABLE 2 Continued					
5	300m u/s Westside Road Reach 2	Round Corrugated metal	900mm	21m	May be fish barrier at high flows.
6	600m u/s Westside Road Reach 2	Round Corrugated metal	900mm	15m	May be fish barrier at high flows
7	1km u/s Westside Road Reach 2	Round Corrugated metal	800mm	11m	Culvert is perched at upstream end, was installed high resulting in hump in road, appears to cause back-flooding at upstream end. Culvert angle is steeper than ideal contributing to potential velocity barrier for fish

4.3) Current water licence use in the watershed

Water licence information for both Abel Creek and Goldie Creek provided by Land and Water BC is summarized in **Table 3.** There is one water licence on Abel Creek and 3 licences on Sunlight Creek. On Abel Creek, the DOI has a water license that amounts to 3,650,000 gallons/year. There have been past incidences when water flow has stopped in Abel Creek. Water licenses for some properties on the lower reach of Abel Creek were turned over at the time of the municipal boundary extension in exchange for joining the town water supply. (Harmsworth, P 6674 4, pers. comm. Jan 2006)

Table 3. Water licence information on Abel, Sunlight and Goldie Creeks

Stream Name	Licence Number	Purpose	Quantity/Units	Licensee Name
Abel Creek	CO45664	Waterworks local authority	3,650,000 GY	DOI
Sunlight Creek	CO60669	Domestic Irrigation	1000 GD 23.2 AF	Wilmac Holdings
Sunlight Creek	F019123	Domestic Irrigation	500 GD 175 AF	A. & G. Potter
Sunlight Creek	F063735	Irrigation	50 AF	Wilmac Holdings
Goldie Creek	C026458	Domestic Irrigation	500 GD 20 AF	D. & S. Moneo
Goldie Creek	C043970	Irrigation	35 AF	McKay, J., & J.
Goldie Creek	C051365	Domestic Irrigation Domestic Irrigation	500 GD 72.6 AF 500 GD 72.6 AF	Royal Antler Ranch
Goldie Creek	C059982	Waterworks local authority	306,600,000 GY	DOI

Goldie Creek	C060003	Storage	350 AF	DOI
Goldie Creek	C064859	Irrigation local authority Waterworks local authority	300 AF 36,500,000 GY	DOI DOI
Goldie Creek	C064860	Waterworks local authority	21,000,000 GY	DOI
Goldie Creek	C064861	Waterworks local authority	547,500,000 GY	DOI
Goldie Creek	C100245	Domestic	500 GD	M. Terpstra
Goldie Creek	C101686	Irrigation Storage	80 AF 80 AF	D. Weaver
Goldie Creek	C114193	Irrigation	150 AF	C. Zehnder
Goldie Creek	C114208	Storage	400 AF	C. Zehnder
Goldie Creek	C114230	Irrigation	500 AF	C. Zehnder
Goldie Creek	C114231	Storage	500 AF	C. Zehnder

GY= Gallons/year, AF= Acre Feet, GD= Gallons/day

There are a total of 13 current water licences on Goldie Creek. On Goldie Creek, the four water licenses are used for the purpose of Waterworks local authority and held by the DOI, amounting to annual allocation of 911,600,000 gallons. Averaged over 365 days per year this amounts to 2,497,534 gallons/day or 1,734 gallons/minute for the DOI. The other water licenses issued on Goldie Creek are for domestic, irrigation, and storage purposes. If these other water licenses held on Goldie Creek are tallied, the total amount allocated is 2,650 gallons/ day. When the total water licenses on Goldie Creek in AF (acre feet) are tallied, the total is 19,102 AF. The unit "acre feet" is the amount of water to cover an acre of land to one foot in depth. According to BC Environment staff, Goldie Creek is "fully allocated", meaning that no additional water licences will be given on this creek. However, BC Environment does not have any flow records in Goldie Creek (Robin Lavallee, BC Environment, pers.comm. March 2006).

Goldie Creek has been partly diverted into the Paddy Ryan Lakes to increase volumes of water for municipal use. This diversion of Goldie Creek into the Paddy Ryan Lakes uses between 20-100% of the total flow in Goldie Creek, depending on time of year. (B. Nickurak DOI, pers. comm. March 2006)

4.4) Preliminary landowner contact around Abel Creek

Generally landowners adjacent to creeks are appreciative of these unique habitats and are already engaged stewards. They may differ, however, in their picture of what a healthy stream and riparian corridor should look like and what rights they have towards the use of the water flowing in the creek.

Extensive landowner contact was beyond the scope of this phase of the project. However, some landowner interviews were conducted both by phone and at their homes with site visits to the creek. Land owners can provide a wealth of valuable information about the history of a creek as well as present observations and concerns.

TABLE 4 provides a summary of the landowners adjacent to the creek that should be consulted, informed and engaged in any restoration and stewardship initiatives involving Abel Creek. Lots with names beside them indicate landowners contacted during the research of this report.

Table 4: Landowners Adjacent Abel Creek

Lot # per Stream Reach	Comments
Reach One P 1052 7 and 8 Niddries P 6674 1 and 3 Copes P 6674 2 Harmsworths P 1052 10 (Renners) P 6674 (4) Hales P 3019 P1052 7,8 and 9 P 1448 Askeys 15621	All within DOI, zoned RR-2 and are small rural acreages. At time of subdivision setback of 15m either side applied to creek side properties. Residents contacted are engaged stewards of Abel Creek.
Reach Two P 16539 P 16539 (2) P 8796 L Johnston E Rosenfeld NES2219 SL 1-4 NES2331 SL 1-5 P 9579 Lot 4616 (P2)	Reach 2 is mostly within the District of Invermere with a variety of zonings, partly RR-2, two small subdivisions RR-1, the Castle Resort Development RES-1 and L 4616 as P-2 public parks and open space.
Reach Three DL 8343 (Stoll) DL 4596 Grizzly Ridge Properties Ltd.	Mostly flows through DL 4596 (GRP) and currently within RDEK.
Upper Watershed Zehnder Farms SL 163 DL 4596 GRP Ltd.	It will be more effective for planning to conduct habitat assessments and inventories before further development.

Almost all of reach 3 flows through sublot DL 4596 part of Grizzly Ridge Properties Ltd (GRP). which owns a total of 3,280 acres at the westerly and southerly boundaries of Invermere. The stage one concept plan of Westmount Estates shows plans for 242 single family lots, 220 townhouses and 378 multi-units. GRP proposes 1,173 acres for annexation into the DOI including the upper reach of Abel Creek. This proposal provides an opportunity for the DOI to have input to the development plans that is consistent with the vision of a greenways network and preservation of water quality/quantity in the watershed. The scale of this proposal and potential impacts on not only Abel Creek but the entire watershed makes it

a priority for the habitat inventory and water monitoring to be expanded to the whole watershed.

The Castle Rock development encompasses 306 acres with the first of two phases completed. During initial construction, Johnston Road was used for access to the development. A steep slope on the south side of Johnston Rd./ Abel Creek slid and closed the road temporarily and may have been due to logging and construction activities from the development. Ads for Castle Rock identify Abel Creek and associated environmental reserve as a selling feature making the developers and new owners excellent potential partners in stewardship and restoration initiatives.

5.0 Short Term Restoration and Stewardship Objectives

Recommended short-term restoration and stewardship objectives are listed below and discussed in more detail in the following sections. **Table 5** summarizes the ecological and stewardship objectives for these recommendations.

5.1) Establish Abel Creek Working Group
5.2) Engineering/ fluvial study of Johnson and Sandwell Roads
5.3) Water quality and flow monitoring in Abel Creek and watershed
5.4) Fish Inventory and habitat assessment
5.5) Increase education efforts around water consumption and stream health

5.1) Establish an Abel Creek working group

This Working Group already informally exists whenever there is a conflict between the road and stream. One of the benefits of a working group is to support the District and Provincial Ministry staff that deal regularly with backed-up culverts, instable bank slides, washed out roadways, siltation in the creek, and a compromised riparian zone. Currently this is done on a reactive basis. A goal of the Working Group would be to turn a losing situation for the road and creek into a winning situation for both by reducing road maintenance costs, and ensuring the protection and restoration of the creek. The Working Group would be tasked with directing the short term restoration objectives for Abel Creek.

Some of the issues for the working group to address include:

- raising funds for achieving objectives
- oversee and implement the recommendations of an engineering/ fluvial study
- produce a map showing stream locations, property boundaries, road culvert locations as well as proposed alternative road routes for greenway network

5.2) Engineering / fluvial study of Johnson and Sandwell Roads

The lower part of Johnson Road (near the intersection with Westside Road) is an on-going maintenance problem requiring regular placement of fill to maintain the road level. Abel Creek overflows its banks in this lower section, presumably due to in-filling of road

gravel into the stream channel that raises the bed elevation. Ice flow is impeded under certain winter conditions in some culverts in both reaches 1 and 2, which in turn leads to water overflowing the channel banks and flooding portions of Johnson and Sandwell Roads. Further removal of in-stream and riparian vegetation such as willows to prevent ice jamming is not recommended and should not be viewed as a short-term solution; it is a step in the opposite direction in terms of ensuring the protection of a functioning riparian buffer.

The purpose of the engineering study should be to make specific recommendations on the feasibility of shifting the road away from the creek to increase the riparian buffer between stream edge and road edge. The study should identify problem culverts in reaches 1 and 2 both in terms of floodwater carrying capacity and slope and elevation in relation to roadbed. Alternatives to culverts should be identified by location where possible. Ideally the study would provide a list of priorities for making the road more maintenance free while also providing fish habitat benefits, and would address some of the issues raised in the previous paragraph.

5.3) Water quality and flow monitoring in Abel Creek and watershed

Integral to a successful restoration plan is the commitment to ensure that a stream has year round flows. It is hardly worthwhile to spend effort and money on physical in-stream habitat improvement if the quality and quantity of water in the stream is not sufficient to support aquatic life.

Since a portion of Goldie Creek is diverted into the Paddy Ryan Lakes, monitoring should be extended to include the Goldie Creek watershed. Issues on Goldie Creek include a ford at the power line, low flows and cattle grazing in the watershed. (Peter Holmes, MOE, pers. comm. March 2006)

The purpose of a water monitoring program would be to;

- monitor water consumption by municipal water use
- monitor flows year round in Abel Creek and watershed, particularly during peak water use and low summer flow periods (August through to Kokanee spawning)

The District of Invermere has two ways to monitor municipal water consumption

- by bulk metering at the plant outlet
- household water metering

The DOI currently monitors outflow of water into Abel Creek. In addition to monitoring the flow at the outlet of the lake, there should be a permanent benchmark monitoring station in reach 1 and 2 of Abel Creek. Water flow in Goldie Creek should also be monitored in a couple of locations to create a year round picture of flow fluctuations.

A basic water quality study should also be conducted in conjunction with the flow-monitoring program, at the same permanent stations. Temperature, dissolved oxygen, and pH should be the minimum of parameters monitored. Chloride measurements can be a good indicator of industrial, road salting and/or municipal water treatment contamination (Masse and Miller, 2005), and ideally should be a component of the sampling program.

These studies could involve local landowners, community groups, and interested residents. Streamkeepers is a well-established program that provides instruction and outlines the appropriate methodology for water quality data collection.

Outreach efforts can inform visitors and residents of water conservation practices and connect these efforts to the protection of Abel Creek.

5.4) Fish Inventory and habitat assessment

Based on the findings of the literature search conducted for this report, relatively little biological information about Abel Creek is available. Aside from an overview study of the drainages to Windermere Lake conducted by Griffith in 1994, there has been no comprehensive study of the Abel Creek watershed. Launching a restoration endeavor without some baseline biological information is not a recommended approach. The goals or focus of the restoration effort can be better tailored to suit the habitat needs after the habitat assessment is complete. Methodologies for community directed habitat assessments have been developed through SHIM. SHIM has been used by various communities, particularly in the lower mainland and Vancouver Island.

At a very minimum a habitat study should include:

1. Inventory and distribution of fish species in the watershed. The geographic scope of such a study should encompass the entire watershed (Abel Creek, the main lakes, and upstream tributaries. The study should be conducted at low flows, preferably in August.
2. Location and mapping of spawning and rearing habitat; location and description of fish migration barriers in Reach 2 and beyond. The study should also include a fall Kokanee spawner survey to confirm number of spawning pairs, location of spawning habitat and redds, upstream access and migration barriers in Reach 1.
3. Describe condition of riparian buffer (width, maturity, species), and describe existing land development activities, with recommendations for impact mitigation and riparian restoration.
4. Provide a to scale map showing stream channel location, road location, and locations of features such as fish migration barriers, driveways, culverts, bridges, beaver dams and lodges, etc.

5.5) Increase education efforts about water consumption and stream health

Invermere has water metering, a well documented way to reduce household consumption of water. Several water conservation programs have been launched in the area. Wildsight has a multi-year project focusing on Lake Windermere water quality. The RDEK had weekly ads focusing on ways to reduce household water use. The Columbia Valley Botanical Garden and Centre for Sustainable Living is delivering a Community Outdoor Water Efficiency Campaign (COWEC) to research, demonstrate and teach about reducing outdoor water use in gardens and lawns. The District of Invermere is a partner with all of these initiatives.

Table 5. Objectives of short term restoration recommendations

Action	Ecological Objective	Stewardship Objective
5.1 Form a Abel Creek Working Group	To focus on protecting and enhancing the ecological integrity of the the riparian and aquatic zone of Abel Creek.	Group would take input from landowners and interested public. Would be an avenue for interested public to participate in the restoration process. District of Invermere would be a role model for stream stewardship by promoting greenways.
5.2 Engineering study of Johnson Road	To highlight key areas of Johnson and Sandwell Road where engineering improvements will also achieve stream channel restoration objectives.	Identify short term solutions to current maintenance problems (ie. problem culvert replacement/removal for example). Provide specific recommendations for the Working Group that support the long term stewardship objectives.
5.3 Undertake a study to monitor flows and basic water quality parameters in Abel Creek and Goldie Creek	To understand flow characteristics of Abel Creek particularly during low flow/high municipal water use periods. This information will be used to produce a flow management plan with the objective being ensuring year round flows throughout Abel Creek.	DOI could partner with community volunteers to collect water quality and quantity (volume) measurements throughout upper, mid and lower Abel Creek and Goldie Creek.
5.4 Conduct a fish inventory, and habitat assessment	To understand distribution and species utilization of Abel Creek, including upper watershed and tributaries	Could involve interested community members, volunteers, students in data collection/ natural sciences; fall Kokanee counts could involve schools to become an annual monitoring study.
5.5 Increase education efforts, with a focus on local residents, towards water conservation & water quality preservation drawing on parallels between water use and survival of Abel Creek	To conserve water and preserve water quality so that Abel Creek has sustained year round healthy flows.	All Invermere citizens become stewards of Abel Creek by monitering household water use. Engage water license holders, ranches, about specific measures to preserve water quality; review water use of current water licences and wells near creek.

6.0) Long Term Restoration and Stewardship Objectives

Recommended long-term restoration and stewardship objectives are listed below and discussed in more detail in the following sections. **Table 6** summarizes the objectives for the following recommendations.

6.1) De-activation of lower Johnson road in Reach 2 near Westside Road intersection
6.2) Removing/replacing selected culverts with bridges or with bottomless arch culverts
6.3) De-activation of lower Sandwell Road
6.4) Initiate stream restoration actions on other streams flowing into Windermere Lake, in particular Goldie Creek.

6.1) De-activation of lower Johnson road in Reach 2 near Westside Road intersection

In the most ideal setting, Abel Creek would not have a road in such close proximity to the stream edge. The best scenario for the most highly impacted reach #2 of Abel Creek would be the closure and de-activation of Johnson Road, with the main culverts along Johnson Road removed and restored to a natural channel and a riparian area could be replanted where the current road exists. Abel Creek would reclaim the valley in which it once naturally flowed.

With so many landowners using these roads as primary access to their homes this is not an easy scenario. A more possible scenario is the deactivation of a portion of lower Johnson Road that would tie in to the construction of an alternate route for residents living on Johnson Road. There will be a reduction in the frequency of traffic on Johnson Road if it is transformed in to a cul de sac that is accessible from the upper direction. The lower portion of the stream channel could be completely restored, and riparian buffer could be widened. Many of the current landowners use Johnston Rd. already as a walking area for dogs, horseback riding, biking. (E. Rosenfeld, L 8796)

In addition to the benefits brought by a vibrant greenways network, the District of Invermere would be reducing its road maintenance costs.

The community of Campbell River, which has a very committed Greenways vision in their OCP, has closed a road to public use that parallels a fish-bearing stream (ERT Road). The road has been converted to a trail used for walking, horse riding and cycling. Obviously the move to close the road was not welcomed by all, but it demonstrates the commitment on behalf of the local government to meet long term Greenways objectives, and to work towards improving past wrongs. Key to successful closure of a public road is first providing a good alternative access; this could be integrated into long term municipal planning with developers.

A regional Greenways initiate (Columbia River Greenways Alliance) has already been established and preliminary work on greenways network within the municipality has been done.

6.2) Removing/replacing selected culverts with bridges or with bottomless arch culverts

Some of the maintenance problems on Johnson and Sandwell Roads are related to inadequately sized and or improperly installed culverts. The corrugated metal culverts found throughout the watershed are the least favored by fish both in terms of passage, habitat quality and utilization. A long-term plan would see the removal of the most problematic culverts, and replacement with bridges or bottomless arch culverts, which at least maintain a

natural stream channel. The engineering study recommended as part of the short-term restoration should help prioritize culverts that need replacement, along with feasible options.

Converting stream crossings from culverts to bridges is costly, and also requires road closures during the construction activities. Benefits are a net gain in habitat over the length of the culvert replaced. Culvert replacement or removal should be integrated in to the long-term restoration strategy for the watershed.

Since kokanee were introduced into Lake Windermere they have been spawning in Abel Creek. For at least fifteen years school children have been coming to learn about kokanee salmon in a small but productive section of stream habitat between the railway and the 1st driveway culvert at the Askeys. Although this culvert is not a barrier to kokanee movement, replacing it would restore a valuable section of habitat and provide a viewing platform. This is perfect example of a restoration/ stewardship project which could involve the community. It is also an example of a project that would only be worthwhile if the upstream protection is in place to prevent siltation and pollution that destroys kokanee eggs.

6.3) De-activation of lower Sandwell Road

De-activation of lower Sandwell Road may be feasible in the long term as there is only one driveway accessed at the end of the no through road. If a conservation purchase could be negotiated for the lower-most lakeside property, Sandwell Road could also become a cul-de-sac with access for residents, and tied into a community greenway.

Table 6. Objectives of long term restoration recommendations

Action	Ecological Objective	Stewardship Objective
6.1 De-activation of lower Johnson road in Reach 2 near Westside Road intersection	Complete restoration/reclamation of a section of Abel Creek to its natural pre-development state.	Road would be removed with a narrow interpretive trail left intact. Stream channel works (complexing of habitat and increasing channel meanderings) could be complemented by increased riparian habitat native plantings with participation by stewards/public/students.
6.2 Removing/replacing selected culverts with bridges or with bottomless arch culverts	To create a net gain in habitat in the problem culvert areas; removing fish access barriers	Engage landholders and community members through the greenways program.
6.3 De-activation of lower Sandwell Road	Complete restoration/reclamation of a section of Abel Creek to its natural pre-development state.	Lower Abel Creek (near Windermere Lake) would be a site for kokanee spawning viewing, with public trail access only.
6.4 Initiate restoration plan for other Windermere tributaries such as Goldie Creek	Identification of issues or problems with Goldie Creek, especially with regard to flows, given the large number of water licenses on the creek.	Rationale for restoring Abel Creek should be applied to other major tributaries in the DOI, particularly in watersheds where land development pressure is not felt.

7.1) Partners, funding sources, costs and table of project timelines,

Other stream restoration and stewardship projects in the region have received funding from a variety of sources.

The Columbia River Greenways Alliance spearheaded restoration of Sinclair Creek near Radium Hot Springs with funds from the Columbia Basin Fish and Wildlife Compensation Program, Fisheries Renewal BC, Science Council of BC, Slocan Forest Products, John Wolfe Construction Co. Ltd., Baymag Mines, Ministry of Transportation and Highways, Village of Radium Hot Springs, the Lake Windermere Rod and Gun Club, Canyon Camp RV Resort and Prestige Inns.

Wildsight's Mark Creek Recovery Program in Kimberley received funds from the Columbia Basin Trust, Environment Canada's EcoAction Fund, Habitat Conservation Trust Fund, Tembec, Shell Environment Fund, Unilver/Evergreen Aquatic Stewardship Fund, Lindsay Park Elementary School, Kimberley Garden Club, Kimberley Foundation and Human Resources Development Canada.

Other possible regional organizations and initiatives to explore partnership links with the Abel Creek restoration effort include:

Columbia River Greenways Alliance
Columbia Valley Botanical Garden's Community Outdoor Water Efficiency Campaign
Cows and Fish Program
DOI's Drought Management Bylaw
East Kootenay Conservation Program
Environmental Farm Planning Program
Trout Unlimited
Wildsight Lake Windermere Initiative

Table 7. Action plan for Abel Creek restoration with cost estimates, partners and time lines

Action	Potential Working Partners and /or Funders	Budget Estimated	Timing
Establish Abel Creek Working Group	EKCP, MOTH, MOE, Wildsight	20K	2006- High priority
Engineering/ fluvial study of Johnson and Sandwell Roads	Castle Rock, DOI, MOTH	20K	2006-High priority
Water quality and flow monitoring in Abel Creek.	GRP Ltd., DOI, CBT, MOE	10K/year	2006-multi year-High priority
Water quality and flow monitoring in watershed, including Goldie Ck.	GRP Ltd., CBT	10K/year	2006-multi year
Fish Inventory and habitat assessment for Abel Creek.	CBT, GRP Ltd., HCTF, DFO	15K	2007
Fish Inventory and habitat assessment in watershed	GRP Ltd., HCTF	25K	2007

Table 7 Continued			
Increase education efforts around water consumption and stream health.	Wild BC, Wildsight CVBG, RDEK, CBT	10K	On-going
Culvert replacement, dependent on recommendations from Engineering study	MOTH, MOE	100K	On-going
De-activation feasibility study for lower Johnson and Sandwell Roads	MOTH, RDEK, DOI Local Developers	20K	2008
Initiate restoration plan for Goldie Creek including preliminary fish inventory and habitat assessment	CBT, HCTF, DOI, RDEK	25K	2009

References

Reconnaissance (1:20,000) Fish and Fish Habitat Inventory of the Stoddart Creek, Shuswap Creek, Bornais Creek and Windermere Creek Watersheds, Artech Consulting Ltd. 2002

A Reconnaissance Survey of Windermere Lake, RP Griffith and Associates, Mica Fisheries Compensation Program, BC Hydro/ BC Environment, Nelson BC February 1994.

2005 Windermere Lake Water Quality Monitoring Program and Literature Review. 2005. Prepared for the Regional District of East Kootenay. Prepared by Masse and Miller Consulting Ltd.

Sinclair Creek Rehabilitation Project Performance Monitoring 2000, SCBC Reference No. FS00-25, Naito Environmental, Vernon

Sinclair Creek Fish and Fish Habitat Assessment, Final Report, March 31, 2001 Naito Environmental, Vernon, BC

Meredith Hampstead, Brian Nickurak, Keith Anderstad, District of Invermere

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Robin Lavallee, Land and Water, B.C., Cranbrook office

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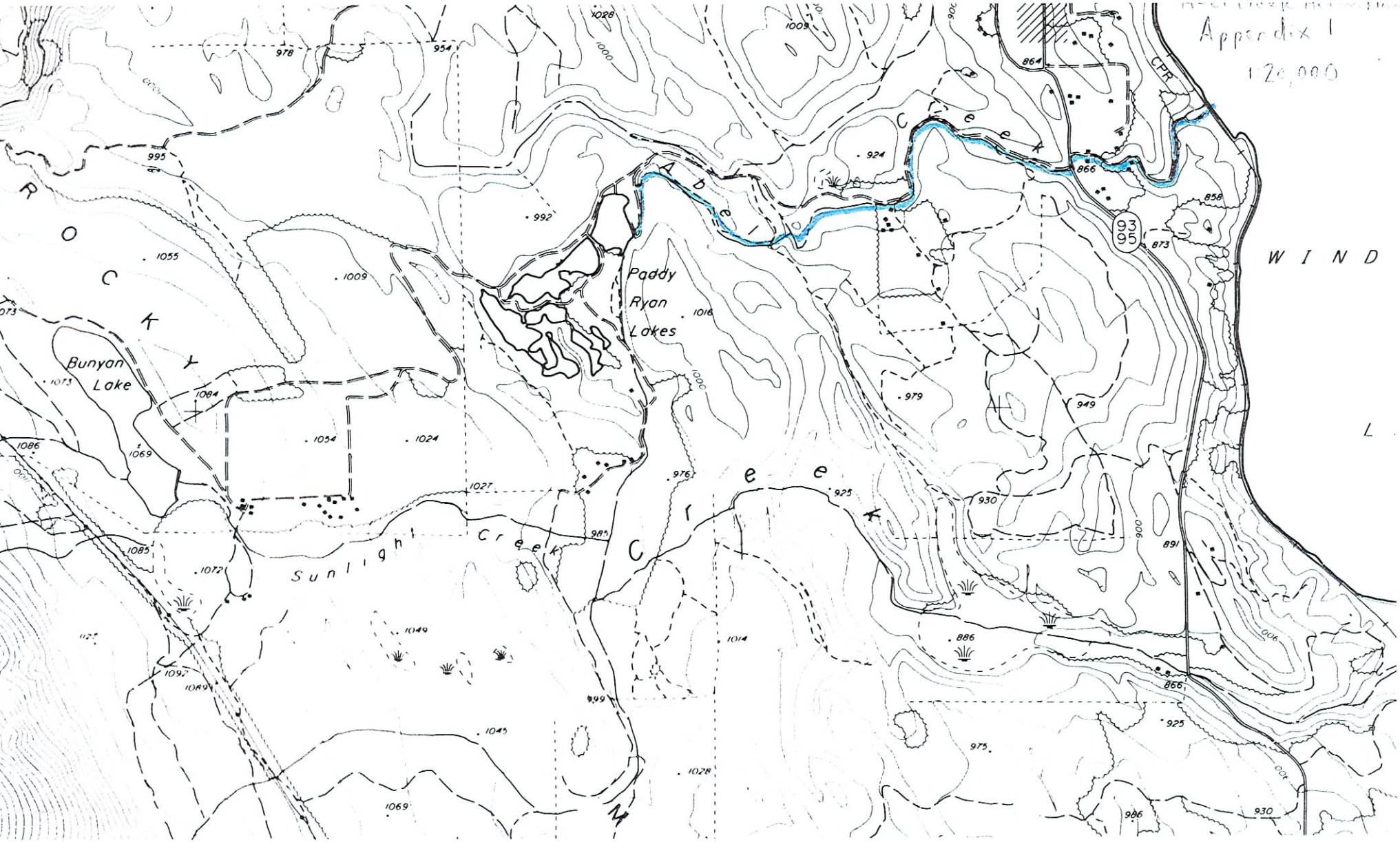
Kathleen Wilker, Focus Engineering Ltd., Invermere

Jason Schleppe EBA Engineering, Kelowna, BCh


Appendix I
1:20,000
Abee Creek
Paddy Ryan Lakes
Bunyan Lake
Sunlight Creek
Creek
CPR
93
95
WIND
ROCKY