Duncan – Lardeau Flats Conservation Properties
Land Management Plan

Prepared for:
Fish and Wildlife Compensation Program
Nelson, BC
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Executive Summary

The Fish and Wildlife Compensation Program (FWCP) and The Nature Trust (TNT) co-manage 11 properties in the lower Duncan River valley of southeastern British Columbia. These lands were acquired in part as compensation for habitat lost due to impacts from BC Hydro dams. In recognition of the fact that over a decade has passed since completion of the last management plan for the properties (Poole et al. 1999), which was primarily wildlife-based, and to reflect changes resulting from the purchase of additional properties and the need for a broader focus on biodiversity conservation, FWCP and TNT are updating the land management plan for the Lower Duncan River Conservation properties.

We followed a biodiversity approach to develop the Lower Duncan River Conservation Properties Land Management plan. Background information on wildlife and wildlife habitat inventory and related management planning was compiled. An Open House at the Meadow Creek Community Hall was held to gather input. Habitat evaluations on the properties were conducted and updated habitat mapping was produced using recent digital orthophotos and field sampling results. The plan uses these elements to identify biodiversity targets for the area and related goals, threats, and actions to reduce threats. An Archaeological Overview Assessment of the Lower Duncan properties complex, a Fire Prevention and Control Plan and an historic review of Duncan Public Advisory Committee were prepared in support of this strategic plan and submitted as separate reports.

Eight biodiversity targets were described for the properties; two habitat-based targets (Forest Habitat; Non Forest Habitat) and six species targets (Elk, Grizzly bear, Bobolink, Painted Turtle, Waterfowl, Kokanee). We rated the impact from seven threats to each biodiversity target in a risk matrix. Non-forest habitats and Western Painted turtle were considered at highest risk; most significant threats were considered to be from invasive plants and unmanaged motorized access.

An action plan was developed which outlines 23 actions to address threats and includes geographic scope, priority, cost, timeline for each action.

Twelve readily measured indicators are proposed as means to assess effectiveness of plan implementation.

Recommendations

- High Priority actions from Action Plan (Table 9) should be implemented:
    - invasive plant inventory and plan to compliment ongoing work
    - access management plan implementation (gates & signage)
    - habitat restoration on suitable portions of agricultural fields
    - TNT to develop “Service Agreement” with SE Fire Control Centre (MFLNRO) to clarify wildfire control roles and responsibilities.
    - Continue ongoing operations to limit and reduce Canada thistle, potentially through an agreement with local groups

- inventory of provincial species-at-risk and local species-of-interest (barn swallow, olive-sided flycatcher
- Investigate process to establish conservation covenants, other notations of interest for crown lots (DL's 1549, 257) that have been incorporated into current plan , as well as covenant potential on BC Hydro property downstream of Duncan Dam (DL 882).
- A regional ad-hoc Advisory Committee has been convening over the past few years. This committee has provided general input to the development of the draft management plan. It is recommended that an Open House be held every 2 to 3 years in Meadow Creek to update community on actions completed and outline future actions. This event should be held in conjunction with other initiatives in the area such as WildsafeBC and Friends of the Lardeau River and the ad-hoc Advisory Committee should be invited.
- An annual budget proposal should be prepared for submission to FWCP, TNT, and other potential funding sources. Ongoing base operations will require $25K/yr. Yearly project costs including prescriptions and implementation of prescriptions will range from $25,000 to $85,000. Bear Smart and Bear Aversive conditioning initiatives are not included in these totals, as they are funded separately. Co-operative funding and co-ordination with the Invasive Plant Committee, CBT, and RDCK would be beneficial. Implementing habitat restoration prescriptions will require stand-alone project budgets that will decrease following establishment of target vegetation communities.

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Acknowledgements

Dennis Hamilton and Steven Wilson gathered and prepared initial plan material upon which this Land Management Plan was developed.

To staff at the Fish and Wildlife Compensation Program, we extend special thanks to Angus Glass for organizing and facilitating the public open house in Meadow Creek in May 2009, to the always cheerful Beth Woodbridge for administrative support when needed and for compilation and data entry of the open house questionnaire responses, and to Amy Waterhouse who provided GIS support, working in cooperation with Kathleen McGuinness (Touchstone GIS Services). Kathleen's on-going GIS support was invaluable. Brenda Herbison assisted with field studies.

Key stakeholders involved in development of this plan included representatives from the Fish and Wildlife Compensation Program, The Nature Trust, individual stakeholders and community representatives from the planning area. This local support included assistance with habitat field studies (lining up canoes for water-only access sites, accompanying us on field work), providing history on ecological and social issues as well as past and present local planning processes, and with providing on-going communication and support for the project.

The initial meeting and associated field trip with local landowners was attended by Tom Fussey, Audrey Matthews, Ellen Wasser, Jim Lawrence, Ken Sutherland, Grant Trower, Duncan Lake, Bent Haagerup, Dwight Smith, Debbie Smith, Sonja Franz, Terry Halleran, Roy Lake, Jim Mainland, Dick Brenton, Don Edwards, Andy Shadrack, Henk van Tuyl, Vince McIntyre, and Garry Wagner. Written submissions to the public open house questionnaire were submitted by Peter Jonker, Kate O'Keefe, Carl Johnson, Nathan Adrian, Philip Pendini, Sean Kubara, Jane Lynch, Christopher Peterson, Fred Thiessen, Dwight Smith, Richard Green, Joe & Marlene Johnston, Tom Zepp, Jim Lawrence, John Lerbscher, Scott Fettes, Bob Yetter, Lesta Sanders, Manon van Tuyl, Ken Sutherland, Fiona Daniels, Eric Schindlery, Julius Strauss, Rob Leiper, Leslie Auger, Ben Smith, Gary Diers, Betty Tillotson, Rowena Eloise, Grant Trower, Dick Brenton, Terry Halleran and a number of anonymous submissions. Our apologies to anyone we have inadvertently left out.

Special thanks are extended to Terry Halleran and Michele Johnson for their hospitality in sharing their Meadow Creek home as a gathering and conversation point on many occasions. Terry guided us to many special places on the property. Thanks go to Grant Trower for historical and political perspective on many fronts and for making the effort to drop off his canoe for us to use during field studies. Gillian Sanders & Rachel Dugdale were most gracious hosts during extended stays while conducting summer field work.

As part of this plan, Wayne Choquette prepared a report on First Nations values in the lower Duncan, Robert Mitchell prepared a report on Fire Management Planning, and Brenda Herbison carried out field sampling and mapping, provided site histories and prepared a report on the Historical Perspective of the Duncan-Lardeau Flats Public Advisory Committee.

1.0 Introduction

The Fish and Wildlife Compensation Program (FWCP) and The Nature Trust (TNT) co-manage 8 properties located in the lower Duncan River valley of southeastern British Columbia (Figure 1). The properties include fee simple lots owned by the TNT and the Province of BC (MoE/FLNRO) that have been acquired over a number of years for the purpose of mitigating some of the fish, wildlife and habitat impacts associated with hydroelectric developments and flooding in the Columbia River Basin (see Utzig and Schmidt 2011). Three crown lots adjacent to these properties are included in the plan as they provide connectivity to the conservation properties (Table 1).

In recognition that over a decade has passed since completion of the last wildlife management plan for the properties (Poole et al. 1999) and to reflect changes resulting from the purchase of additional properties and the need for a broader focus on biodiversity conservation, FWCP and TNT identified the need for a revised land management plan for the Lower Duncan River properties.

The plan embraces an ecosystem-based approach to conservation of biodiversity, expanding earlier species- and property-specific wildlife management plans dating back to the late1970's (Silver 1978, Rafiq 1980, Woods 1981, Woods and Super 1990, Super 1991, Poole and Park 2003, Poole et al. 1999, Davidson 2005, Holt and MacKillop 2006, Herbison 2008).

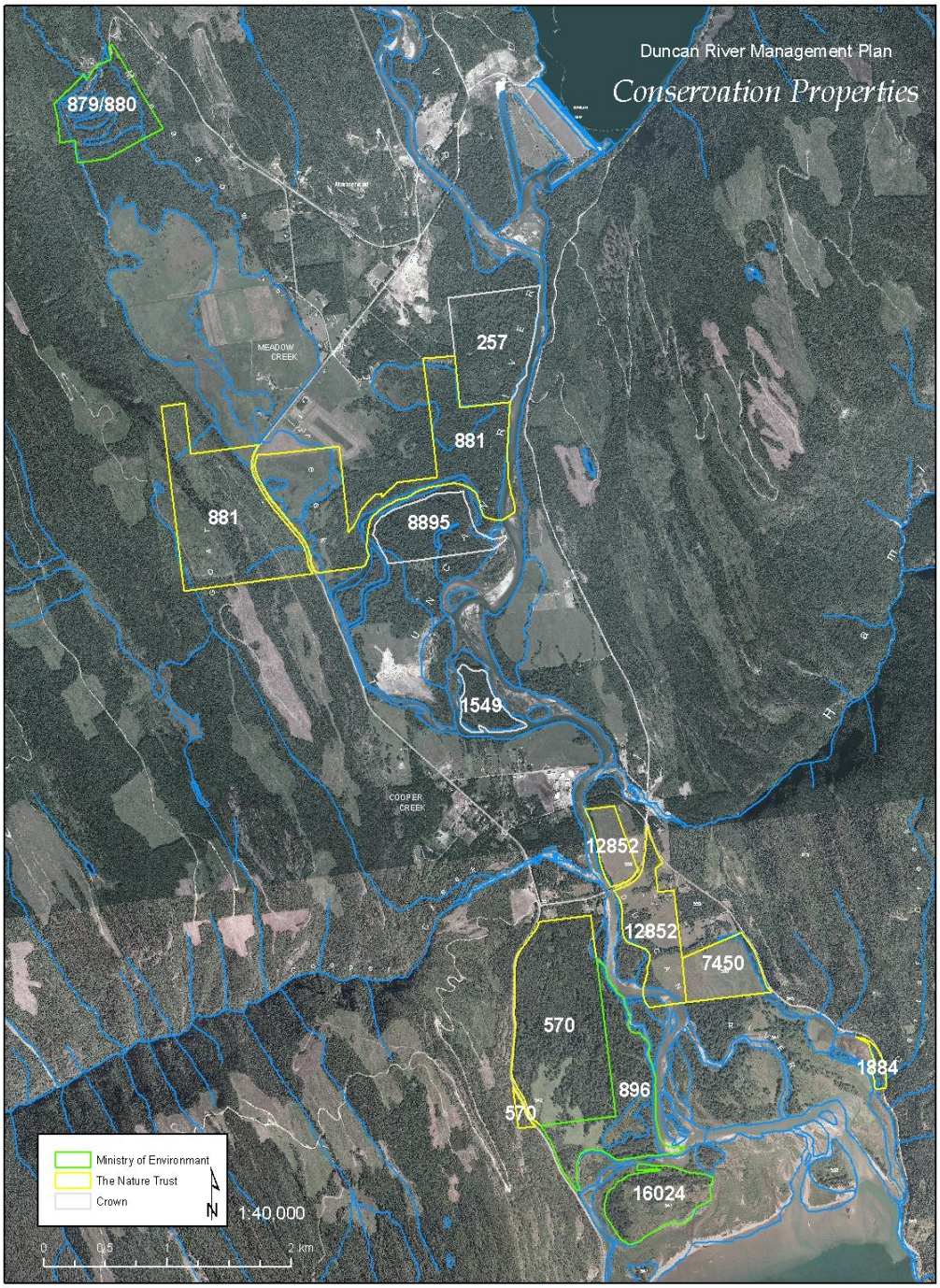

Figure 1: Lower Duncan River properties planning area

Table 1: Legal description and ownership for the Lower Duncan River properties

Legal Description	Date Acquired	Ownership	Area (ha)
DL 16024	1975	MoE	35.8
Lot 1 DL 879 & 880 Plan 9123	1975	MoE	44.8
DL 896 except (1) Parts included in RW Plans 674D and 11178; Parts included in Plans DD 13019 and 5601; (3) Parcel B (see 1035891); Part included in Lot 3822; (5) part included in Lot 2845	1978	MoE	59.2
MoE Total			**139.8**
Lot A DL 1884 Plan 13692	1978	TNT	3.0
Parcel A DL 570 Plan 10952	1984	TNT	111.1
DL 881 except (1) Parts included in Plans 674P, 5895 and 15969; (2) Parcel A (Ex Plan 13559191; and (3) part in DL 898	1998	TNT	212.2
DL 12852, Except Plan 9726, 13794, 16825, Land Dist 26 and Lot1, Plan 6540	2007	TNT	53.8
DL 7450, Land Dist 26	2007	TNT	26.2
TNT Total			**406.4**
DL 1549		Crown	15.2
DL 8895		Crown	36.5
DL 257		Crown	54.4
Crown Total			**106.1**
TOTAL			**652.3**

1.1 Plan Purpose

The purpose of this Land Management Plan is to guide management decisions and operational activities involving habitat restoration and conservation as well as human use on the Lower Duncan River properties.

Vision:
The Lower Duncan River properties will be managed to provide productive, adaptive ecosystems to support native species through time, while maintaining community support.

1.2 Land Management Issues

Agency and TNT staff identified 11 topic areas to be considered in the Land Management Plan to guide development of biodiversity targets, assessment of threats, and actions to address threats (Table 2).

Table 2: Issues Identified for consideration in the Lower Duncan River Conservation Land Management Plan

Issue	**Rationale**
1. Agricultural Land Management	Agricultural lands form a significant component of the Lower Duncan properties. Habitat and species goals need to relate back to management actions.
2. Water Management	Operation of the Meadow Ck Spawning Channel requires active water management. Habitat restoration actions must be complimentary to channel operation
3. Access Management	Clear articulation of access opportunities and risks for hunting, fishing, wildlife viewing, motorized recreation is required to maintain community support and protect conservation values.
4. Priority Wildlife Species and Habitat Management	Priority Species: Grizzly Bear; Elk; Bobolink; Painted Turtle; waterfowl and kokanee need specific targets and actions to maintain/improve status. Targets for habitat restoration and enhancement actions should relate to these species and for ecosystems present on the properties.
5. Lease and License Agreements	Land rental agreements, access agreements, water licenses associated with properties and adjacent landowners require consideration in developing management actions
6. Non-functioning ecosystems and adversely impacted habitats	Invasive species, land use, changes in water management and access have reduced productive capacity of the lands. Restoration actions should relate to target species and ecosystems.
7. Forest Management	The abundance, distribution, structural stage and condition of upland and riparian forested ecosystems on the properties can be influenced by restoration actions. Old growth/mature forest targets are needed for conifer and cottonwood-leading stands
8. Fire Management Planning	Interface fire concerns need to be considered in terms of community wildfire risk and risks to habitat.
9. First Nations Values	Strategies are needed for maintaining identified FN values in conjunction with other Land Management activities being considered in the plan
10. Creating Community Awareness	Re-establishing a local advisory committee to assist with planning and implementing short term management actions needs evaluation. Identifying opportunities for informational signage and other outreach actions to support plan implementation also needs to be considered
11. Public input to Plan	Direct input by community stakeholders into plan content and priorities will be essential for ongoing support.

2.0 Land Management Plan Approach

Development of the Land Management Plan for Lower Duncan River Conservation Properties involved the following tasks:

1. Agency direction (Table 2), previous management plans, operational activities implemented from Poole et al. 1999 (Appendix 1), background information on wildlife and wildlife habitat inventory and related management planning documents were compiled, reviewed and summarized. These include Dam Impacts Report (Utzig and Schmidt 2011, and references within), Protected Areas Goal 2 candidacy information; Lardeau and Lower Duncan River Watershed Profile (Nellestijn and Decker 2011); and BC Hydro Water License Requirements studies underway; as well as other conservation project information.
2. FWCP and TNT staff and project consultants organized and facilitated a meeting with local landowners on March 27, 2009, where an outline of the proposed strategic planning process, goals and objectives were presented and discussed.
3. In May 21, 2009, a public Open House was organized and hosted at the Meadow Creek Community Hall. Angus Glass (FWCP Communications Coordinator) organized and advertized the Open House, and posted background information and a questionnaire to the FWCP website.
4. During summer/fall of 2009, habitat and biodiversity field sampling of key habitat elements and forest structural conditions found on the properties were completed. Habitat and ecosystem field data were collected using Tree Attributes for Wildlife (TAW; FS882(6) field form), Coarse Woody Debris (CWD; FS882(7) field form) and vegetative shrub (VEG; FS882(3) field form) collection and sampling procedures outlined in the *Field Manual for Describing Ecosystems in the Field* (RIC 1998).
5. The 1998 orthophoto-derived vegetative mapping polygons (Poole et al. 1999) were updated based on recent digital orthophotos (2009) and field sampling results. Forest structural vegetative classifications were expanded to included polygon classes for agriculture, gravel pits, residential/industrial and riparian/wetland (Appendix 3).
6. Biodiversity targets, threats, and strategies/actions to reduce threats within the plan area were identified based on tasks 1-5.
7. An Archaeological Overview Assessment of the Lower Duncan Conservation Property Complex was prepared (see Appendix 5).
8. A Fire Prevention and Control Plan was prepared (see Appendix 6).

9. An historic review of Duncan Public Advisory Committee was prepared (see Appendix 7).

3.0 Plan Area Description: Geographical, Ecosystems, Wildlife

3.1 Geographical Description

The plan area includes properties owned by TNT and Province of BC (MoE/FLNRO) and adjacent crown lots located along the Lower Duncan River at the north end of Kootenay Lake and extending northward to the Duncan dam and reservoir (Figure 1; Table 1). The land area in the Lower Duncan River properties managed by FWCP and TNT is approximately 652 hectares. Additional area description is available in Poole et al. (1999).

The Duncan Reservoir covers 7,150 ha reservoir at full pool (576.4 m – 576.7 m elevation). The reservoir receives inflow from the Duncan River in May and June due to snowmelt, and reaches full pool by the beginning of August (BC Hydro DDMMON, 2008). Substantial wetland, riparian forest ecosystems were impacted by construction of Duncan Dam (Utzig and Schmidt 2011). Particularly significant were impacts to wetlands (90% loss; includes - fens, bogs, marshes, ponds, swamps, shallow waters, gravel bars) and riparian cottonwood habitat (67% loss; MacKillop et. al. 2008). The naturally regulated Lardeau River joins the Lower Duncan River just below the Duncan Dam representing approximately 45 % of the lower Duncan source based on watershed area (Miles 2002). Changes in seasonal flows due to the Duncan Dam have affected ecosystems downstream such as cottonwood forests and wet meadows which depend on flooding disturbance. A watershed profile of the Lardeau River (Nellestjn and Decker 2011), provides additional detailed ecosystem, fish & wildlife information.

3.2 Ecosystems

The properties are within the Southern Interior Mountain (SIM) Ecoprovince, North Columbia Mountains (NCM) Ecoregion and Central Columbia Mountains (CCM) Ecosection. The majority of the properties are within the Interior Cedar-Hemlock moist, warm biogeoclimatic subzone (ICHmw2), the southern and eastern portions of several properties include the drier ICHdw1 (Figure 2) These biogeoclimatic zones are characterized as having hot, moist summers with very mild winters with light snowfall (Braumandl and Curran 1992). Snowpack's are generally of moderate depth and duration. Climax zonal sites support stands of western hemlock and western red cedar, and mixed forest of these species and Douglas fir, western larch, and hybrid spruce are common. Black cottonwood/cedar/hemlock dominate river-bottom sites.

The Province of BC Forest Practices Code Biodiversity Guidebook (1995) describes the ICHdw1 and ICHmw2 ecosystem variants found on the lower Duncan properties as Natural Disturbance Type (NDT) 2 ecosystem. These ecosystems typically have infrequent stand-initiating events with mean disturbance return intervals estimated at about 200 years. Natural wildfires are typically of moderate size (20-1000 ha), with unburned areas usually remaining in sheltered terrain and higher moisture areas. Extensive areas of even-aged stands with snags and veteran trees are typical of NDT 2 landscapes. Crown land old seral forest targets of between 10-25% of a landscape, consisting of patches large enough to provide interior forest conditions, are suggested as a management goal.

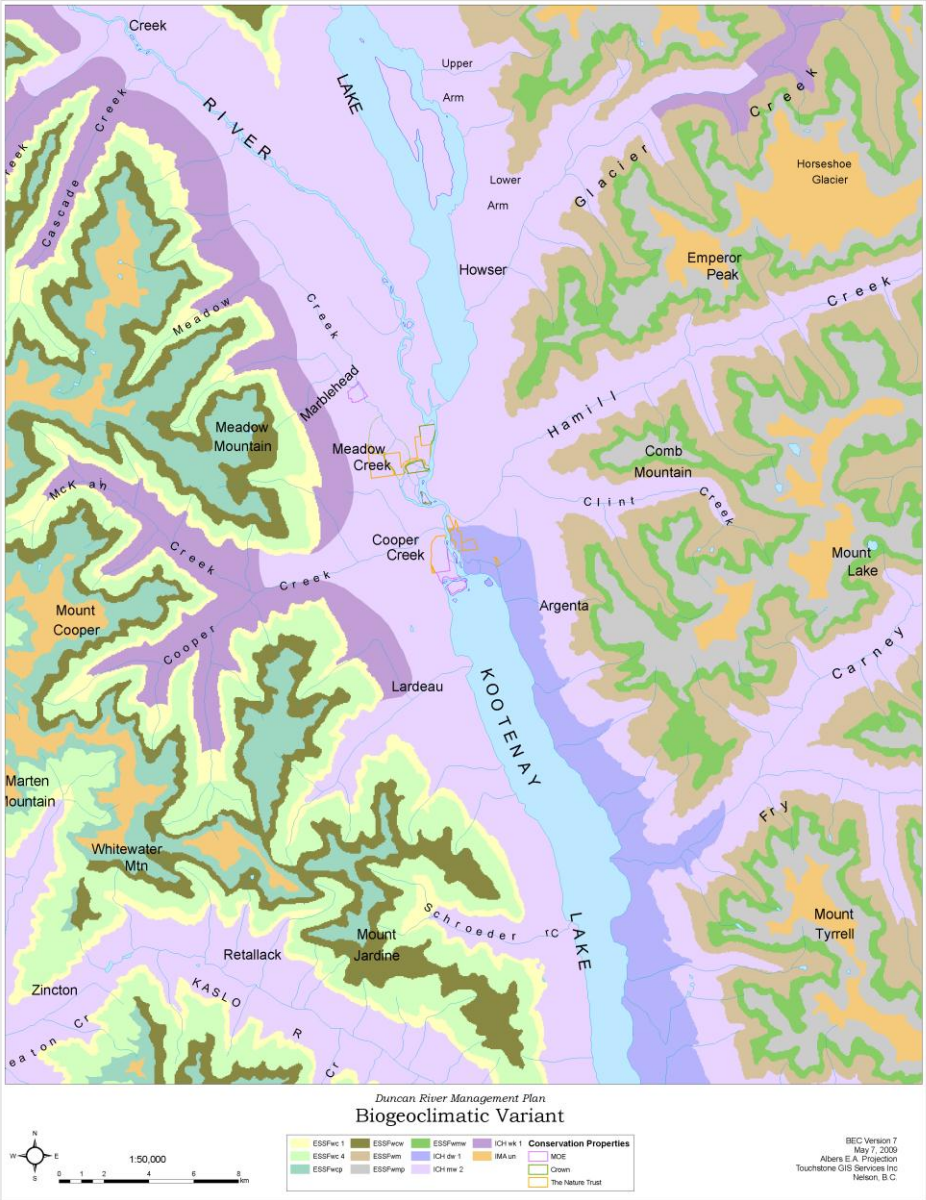

Figure 2: Biogeoclimatic subzone variants within the Lower Duncan River Conservation properties and adjacent landscape include the Interior Cedar-Hemlock moist, warm biogeoclimatic subzone (ICHmw2) and Interior Cedar-Hemlock dry, warm subzone/variant (ICHdw1).

3.2.1 Habitat Mapping

Vegetation mapping from Poole et al (1999) was updated using 2009 BC Hydro orthophotos of the Lower Duncan River. The nine structural classes identified and described by Poole et al. (1999) were carried forward into the revised mapping (i.e., old forest; mature forest; immature forest; early seral forest; grass/forb; gravel bar; shrub; urban; and water), with the addition of agriculture, gravel pit, residential/industrial and wetland, and water classifications (Table 3; see Appendix 3 for definitions of structural

classes). Results from 17 field sampling plots (Figure 3) were used to adjust and clarify polygon boundaries, assign classifications to unclassified polygons, and delineate riparian habitat.

Sampling clearly showed that all forest communities exhibited some level of disturbance and management activity (i.e., logging, slashing, burning, agriculture, roads, trails), with the exception of a small old growth forest patch on DL 8895. Overall these disturbances have reduced amount and distribution of:

- standing dead (snags) and dying trees
- large (50-79cm dbh) and/or giant trees (>80cm dbh).
- larger size classes and volumes of CWD

Despite widespread evidence of a range of human disturbances dating back over half-a-century, over 82% of sample plots supported crown closure of moderate (40-69%) to closed (>70%) canopy conditions; and most of the forest stands sampled were 2-storied (41.3%) or were stands composed of $\geq$3 canopy levels (35.3%)

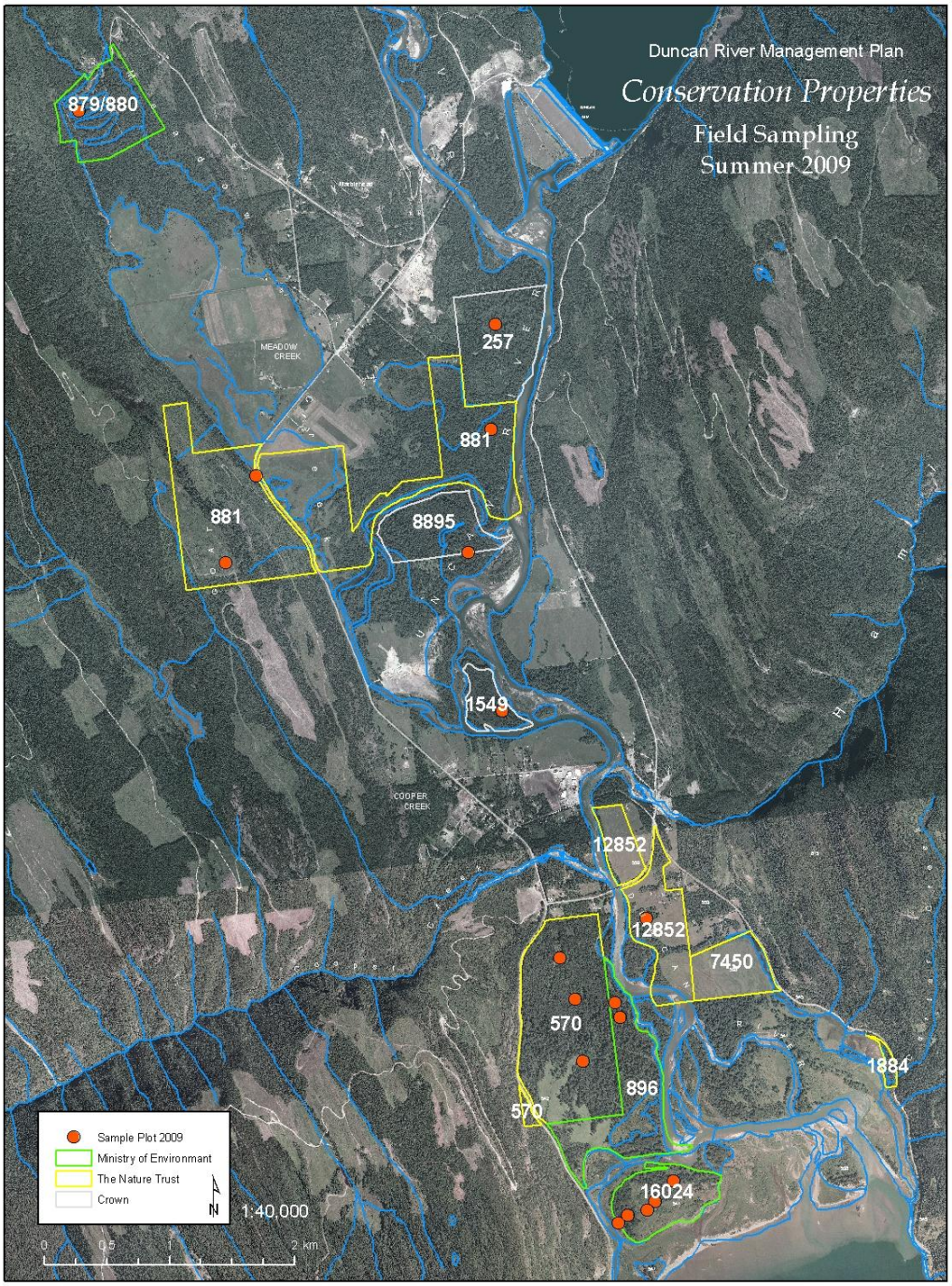

Figure 3: 2009 ecosystem field sample sites on the Lower Duncan River Conservation properties

Conifer and/or deciduous forest ecosystem units are found over 492 ha (75.4%) of the properties, composed mostly of mature forest (55.3%), immature forest (27.5%) and early

seral (13.5%), with old forest representing only 3.7% of remaining forest stands. Non forested units are found over 123 ha (18.9%) of the properties, dominated by agricultural fields (96 ha) and shrub (27 ha). Riparian/wetlands/open water ecosystems represent 1.6% of the properties.

Table 3: Habitat structural stage and land cover area summary of Lower Duncan River Conservation properties.

Property	Agriculture	Early Seral	Grass-forb	Gravel pit	Gravel or Sand Bar	Immature forest	Mature forest	Old forest	Wetland-Riparian	Residential - Industrial	Shrub	Water	Area Outside Structural Stage Mapping*	Total
DL12852	32.4					0.9	14.7			2.6			3.2	53.8
DL 16024						6.0	13.9				15.7		0.1	35.8
DL 1884							2.6		0.1			0.4	0.0	3.0
DL 570	9.6	1.3				2.0	98.3						0.0	111.1
DL 7450	23.3						0.0		0.0			2.7	0.2	26.2
DL 879/880						3.6	38.6						2.6	44.8
DL 881	26.6	32.7	4.9			119.7	11.1		5.2		5.4	0.3	6.4	212.2
DL 896	4.9	0.3					44.0				6.0	0.0	3.9	59.2
DL 1549							14.2						1.0	15.2
DL 8895		0.0		0.8		2.9	13.1	18.2				1.5	0.0	36.5
DL 257		32.1				0.2	21.7					0.1	0.3	54.4
TOTAL	96.8	66.4	4.9	0.8	0.0	135.4	272.1	18.2	5.3	2.6	27.2	4.9	17.8	652.3

*Area that has been lost due to changes in Lower Duncan River channel and the development of the Meadow Creek spawning channel within the original land survey

3.2.2 Forested Ecosystems

As forest habitat predominates within the properties, creating and maintaining a structural class distribution that is within the natural range of variation for similar types of sites is in important goal. Old forest attributes such as large trees and snags, multiple canopy layers, coarse woody debris develop over long periods of time (approximately 250 years; Province of BC 1995; MacKillop and Utzig 2005) under natural disturbance regimes operating in the moist ecosystems of Lower Duncan River Conservation properties. Under natural conditions, old forest structure would be expected to occupy 40 – 50% of the forested areas. Lesser amounts of mature, young and recently disturbed structural classes would make up the balance (Figure 4). Currently, the bulk of the forested area is in the mature structural stage, and very low percentages are considered old growth (Figure 4). Recruiting stands of mature forest into old growth is clearly necessary to move the structural stage composition toward the expected range of natural variability.

Because clearing of forest habitat for agriculture has reduced the total forested area within the properties, achieving mature/old growth targets will be a challenge.

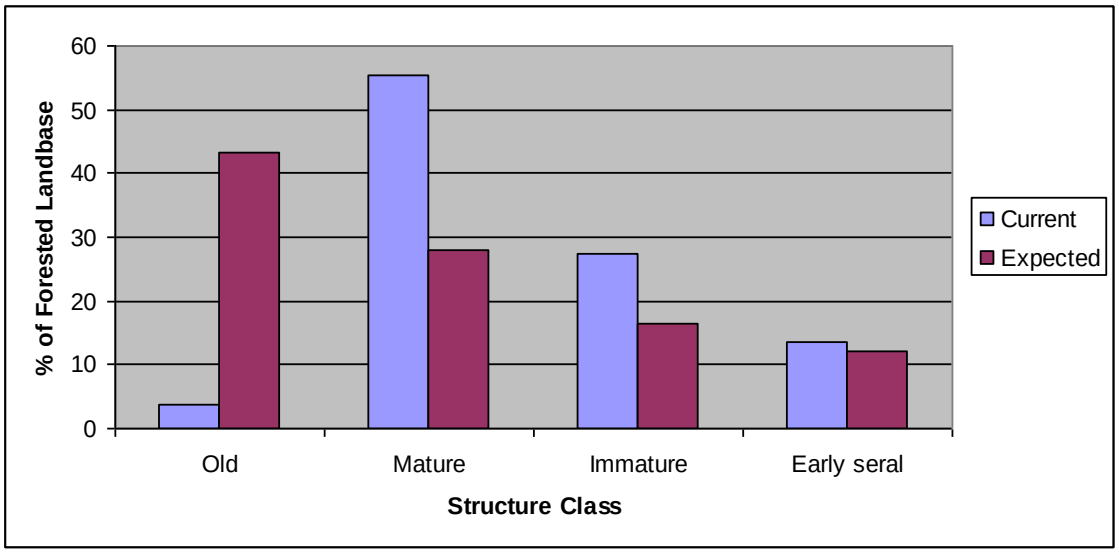

Figure 4: Current and Expected forest structural class composition within Lower Duncan River Conservation properties.

3.2.3 Non Forested Ecosystems

A mix of wetland, shrub and grass/forb sites make up the non-forested ecosystems present on the Lower Duncan River Conservation properties. Dynamic ecosystem processes driven by flooding disturbances from the Duncan River and Kootenay Lake, as well as land use for agriculture and settlement has significantly influenced these habitats. Changes in river flows due to construction and operation of the Duncan Dam, and altered Kootenay Lake levels caused by Libby Dam, and operations downstream on the Kootenay River between Nelson and Castlegar have caused shifts in ecosystem distribution in the areas within and around the Lower Duncan River Conservation properties.

Marsh, swamp and shallow water wetland areas cover limited land area, and have remained relatively stable since pre-dam times (Figure 5). Significant reduction in shrub dominated sites, and increases in agricultural field area have occurred since 1963, as settlement in the area increased. Shrub dominated sites have decreased in area, partly due to sites transitioning to forested ecosystems, resulting from decreased disturbance on the delta at the head of Kootenay Lake. Similarly, seasonally flooded grass/forb (fen wetland) sites have decreased in area as succession to shrub has occurred in sites where flooding disturbance has decreased. The net effect of these changes suggests that despite reductions in shrub and grass/forb (fen) ecosystems, the total area in grass/forb (e.g.

agricultural fields) has increased dramatically due to land clearing. While agricultural fields are not ecologically identical to pre-dam seasonally flooded fens, some functions are supported (e.g. grass forage for ungulates). Grass/forb fens which provided loafing and migratory stopover habitat for waterfowl at the head of the lake have been reduced and have not been replaced functionally by agriculture fields. While the "ecologically appropriate" mix of habitats is not immediately apparent, it seems reasonable to suggest that under conservation land management, recruiting riparian forest and shrub sites via habitat restoration of some agricultural fields, and treatment of some shrub sites to restore grass/forb fens at the head of Kootenay Lake is warranted

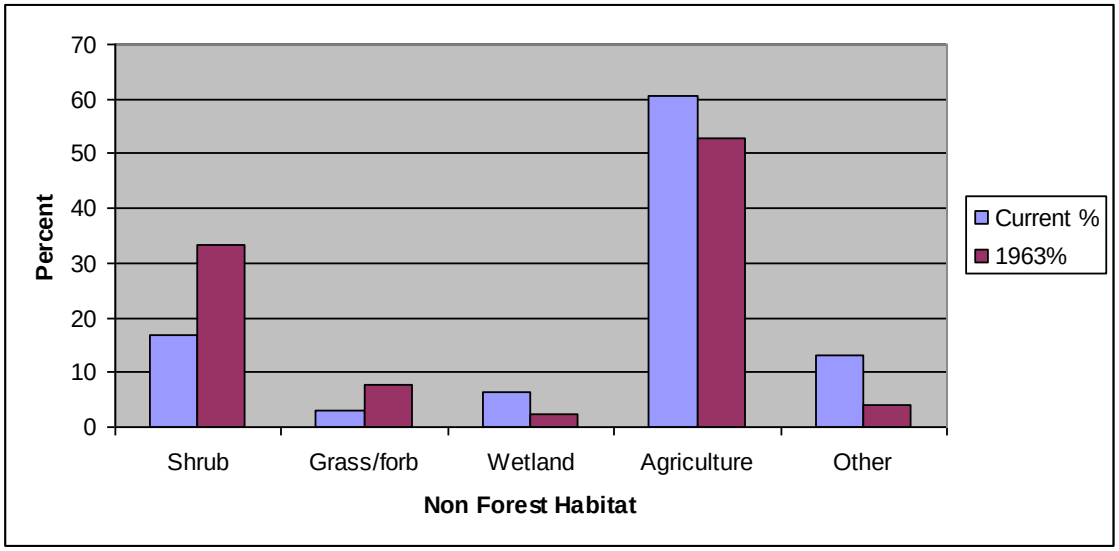

Figure 5: Current and pre-dam (circa 1963) composition of non-forested habitats within the Lower Duncan River Conservation properties.

3.3 Wildlife, Fish and Biodiversity

Poole et al (1999) listed 100 known or suspected vertebrate species associated with the Lower Duncan River area. Updated lists from Manley and Krebs (2011), and Nellestijn and Decker (2011) suggest that 256 species occur in the Duncan-Lardeau watersheds, of which 16 species are currently considered at risk (Table 4). Regionally significant values for Grizzly bear, kokanee, and bobolink are found within the properties (Kootenay-Boundary Higher Level Plan Order, 2001) along with locally significant values for elk (*Government Actions Regulations* (B.C. Reg. 582/2004); Davidson 2005), Painted turtle (Herbison 1996), and waterfowl (Poole et al. 1999).

The properties support a diverse suite of amphibian, reptile, bird and mammal fauna that are intended to be supported through management plan strategies and actions.

3.3.1 Species at Risk

Sixteen species at risk (1 amphibian; 9 birds; 1 fish; 4 mammals; 1 reptile) are known or expected to use the Lower Duncan River properties (Table 4). Fifteen of these are considered priority species in the draft FWCP Columbia Basin Plan (Compass 2011). Grizzly bear, Bobolink, and Western painted turtle are considered to be closely associated with the Lower Duncan River Conservation properties. Limited information on Barn swallow, Olive-sided flycatcher, and western toad suggests they may breed on the properties but inventory is required to confirm status.

Table 4: Species at risk found or suspected on or adjacent to the Lower Duncan River Conservation properties. Provincial and federal listing, BC Conservation Framework ratings as well as FWCP priorities are shown along with the strength of association of the species with the Lower Duncan River Conservation properties.

Species at Risk	Class	BC List[1] [Cons. Framework]	Federal List[2]	FWCP Priority[3]	Association with Lower Duncan River Conservation Properties[4]
Western toad	Amphibian	Blue [2]	SC	Focal	Close
Western grebe	Bird	Red [1]		Focal	Present
Lewis woodpecker	Bird	Red [1]	T	Recovery	Present
Bobolink	Bird	Blue [2]	T	Focal	Close
Great Blue heron	Bird	Blue [2]		Focal	Associated
American bittern	Bird	Blue [2]		Focal	Present
Olive-sided Flycatcher	Bird	Blue [2]	T	Inventory	Unknown
Barn Swallow	Bird	Blue [2]	T	Inventory	Unknown
Vaux swift	Bird	[2]		Focal	Associated
Common Nighthawk	Bird	[2]	T	-	Present
Bull trout	Fish	Blue [2]		Focal	Associated
Grizzly bear	Mammal	Blue [2]	SC	Focal	Close
Townsends big-eared bat	Mammal	Blue [2]		Focal	Associated
Wolverine	Mammal	Blue [2]	SC	Focal	Present
Mtn Caribou	Mammal	Red [2]	T	Recovery	Present
Western Painted turtle	Reptile	Blue [2]	SC	Focal	Close

[1] Blue, Red = Provincial listing; [1, 2] = BC Conservation Framework Ranking

[2] SC = Special Concern; T = Threatened

[3] FWCP priority = from draft Species of Interest Action Plan
[4] C = closely associated; Breed, feeds; local or regional population depends on properties for life requisite; A = Associated; uses properties for part of life cycle; P = Present; known to be present occasionally on properties, or in adjacent habitats; U = Unknown

3.3.2 Grizzly bear

The Lower Duncan River provides important regional connectivity between Goat Range Park to the west and the Purcell Wilderness Conservancy to the east; partly due to the position of Kootenay and Duncan lakes (Poole et al 1999).

Grizzly bears are regularly observed in the spring in Meadow Creek area (solitary individuals, mating pairs, sow with cubs; T. Halleran, *pers. comm.*). Grizzly bears have also been regularly observed in the fall during kokanee spawning at the Meadow Creek spawning channel.

There is an increased tolerance to grizzly bears in the Meadow Creek area resulting from the North Kootenay Lake Bear Smart Program that has been ongoing since 2007. This program combined with the "Less Lethal Bear Management Project" that was initiated in 2011 has reduced the number of "problem" grizzlies that have had to be shot.

3.3.3 Bobolink

Bobolinks inhabit large open hayfields and wet meadows with moderately dense growth of grasses. Breeding numbers are low in the Meadow Creek area with a total of 22 individuals observed in 2007 in 3 separate fields during the last bobolink survey (Spitler 2007). The nearest bobolink populations in the West Kootenay are Creston and Castlegar. Maintenance of suitable nesting habitat composed of a combination of managed and unmanaged hayfields and meadows is essential for the continued presence of this species.

3.3.4 Kokanee

The Meadow Creek spawning channel provides an important spawning habitat for kokanee. The spawning channel is managed by the Provincial Government and in 2010 over 452,000 kokanee were enumerated at the spawning channel (Bell 2011). The operation of the spawning channel is important for both fish and seasonally, for wildlife.

3.3.5 Painted Turtle

The Argenta Slough (DL 1884)/Lake property (DL 7450) wetland painted turtle population is the only known turtle population north of Mirror Lake. Limited amounts of suitable nesting areas and fluctuating water levels in Argenta Slough likely limit population growth. In 2011 there were seven nests in the nesting area adjacent to the

Argenta Road; however, all were predated after egg laying (Herbison 2011). This small population is estimated at 15 -20 individuals.

3.3.6 Elk

Elk were initially introduced to the Lardeau/Duncan Rivers area in 1948 (T Szkorupa, *pers. comm*.) and management of ungulates and their winter ranges has remained a primary local concern and management focus in the area for decades (Silver 1978, Woods 1981 and Poole et al 1999; Davidson 2005).
Within the conservation lands, management of portions of the old agricultural fields and riparian shrub and grass/forb sites at the head of the lake are important for maintenance of elk habitat.

3.3.7 Waterfowl

The Lower Duncan River valley and the habitats adjacent to Kootenay Lake are used primarily as foraging and resting sites for over 70 species of waterfowl, shorebirds and gulls, including geese, tundra swans, American wigeons, teal, scaup, western grebes and loons (Stevens 1995, Davidson 1998). This area is the first major waterfowl resting area on Kootenay Lake north of the Creston-Duck Lake area, 100 km to the south. The area is rated class 4 by the Canada Land Inventory for the production of waterfowl (Rafiq 1980). Common waterfowl species nesting in the area are mallard ducks and Canada geese. Changes in flooding disturbance have affected the abundance and distribution of open grass/forb fens along the lake margin used by waterfowl. Significant losses of wetlands from the Duncan Dam have increased the importance of these areas (Silver 1978; MacKillop et al 2008). Argenta slough, wetland along the eastern margin of DL 7450, and Meadow Creek on DL 881 provide some nesting/breeding habitat for waterfowl.

4.0 Lower Duncan River Properties: Biodiversity Targets, Threats, Actions

Translating the ecological values, risks into a practical, efficient and effective management plan for the Lower Duncan River Conservation properties is needed to meet the goals of the agencies and the community. Eight biodiversity targets are identified as the basis for the plan (Table 5). For each target, goals are identified along with potential monitoring indicators to enable effectiveness evaluation. Two habitat-based targets (Forest Habitat; Non Forest Habitat), and 6 species-based targets (Grizzly bear, bobolink, kokanee, elk, waterfowl, Western painted turtle) capture the breadth of the key natural resource values on the Lower Duncan River Conservation properties.

Table 5: Biodiversity targets, goals and associated monitoring indicators for the Lower Duncan River Conservation properties.

Biodiversity Targets	Goals	Monitoring Indicator
Forest Habitat Sites potentially suitable for self sustaining conifer and/or deciduous tree cover	Forest Area: Recruit new forest to increase total forest cover on properties Structural Classes: Re-establish forest structural class distribution to within the natural range of variability Structural Elements: Increase large diameter wildlife trees within mature and old forest sites Forest Understory: maintain productive native vegetation communities in forest understory	New forest recruited (ha)
Non Forest Habitat Shrub, Grass/forb, Wetland, Agricultural fields	Shrub: Increase area occupied by riparian shrub communities along streams and wetlands Grass/Forb: Maintain/improve condition of natural grass/forb communities Wetland: Maintain existing wetland distribution and function; and enhance/create, where possible wetland area Agricultural Field Area: Reduce total area of agricultural fields by restoring forest or native shrub cover on selected sites Agricultural Field Condition: Maintain and where possible improve conditions on managed fields by reducing invasive plant cover and vigor Agricultural Field Use: provide opportunities for local groups to use of hay on selected fields where appropriate	New shrub habitat recruited (ha) Grass/forb habitat restored (ha) Agricultural field area reduced (ha) Invasive plant cover/distribution decreased
Elk Habitat used by elk during spring, fall, and winter Actions will benefit deer as well.	Manage a portion of the old agriculture fields to produce early spring forage for elk Increase mature/old forest cover to provide snow interception during mid and late winter Treat selected grass/forb sites experiencing shrub invasion to maintain winter foraging habitat at the head of the lake Provide opportunities for elk/deer hunting where safe to do so	Elk distribution in relation to treated areas
Grizzly bear Spring & fall foraging sites Cross-valley linkage	Maintain abundance and distribution of spring bear food plants, and kokanee in concert with	Number of grizzly bear incidents and problem bears shot

	bear-human conflict goals Reduce bear-human conflict in the area by supporting better management of attractants Improve bear-human conflict management at the Meadow Creek spawning channel Maintain or improve viability of cross-valley linkage by managing access on Lower Duncan River Conservation properties	
Bobolink	Maintain suitable nesting cover within old agricultural fields	Presence and distribution of bobolink in area
Western Painted turtle	Maintain functional nesting areas Improve conditions in shallow water wetlands to enhance turtle use	Number, location and success of nests
Waterfowl	Improve migratory stopover habitat condition at the head of Kootenay lake Maintain/improve existing waterfowl breeding habitat	Area of grass/forb fen restored Presence of breeding waterfowl species
Kokanee Mostly captured under MCSC operations	Maintain kokanee spawner access to Meadow Creek Restore natural streamside vegetation where necessary	Kokanee access to Meadow Creek maintained

Threats to the biodiversity targets are a result of current and past land-use practices, as well as changes in water flow/level management (Table 6). We included Mosquito Control as a potential threat until proven otherwise. TNT policy on mosquito control (Appendix 4) provides guidance on circumstances where mosquito control is an appropriate action.

Table 6: Threats to biodiversity targets in Lower Duncan River Conservation properties.

Threats	Description
Motorized Access	Recreational access by trucks, ATV's and other motor vehicles can displace wildlife, spread invasive plants and damage wetlands. User conflicts are likely without a clear access management plan
Invasive Plants	Invasive plants reduce habitat quality for wildlife Disturbances such as fire, land clearing, road use and maintenance contribute to invasive plant spread. Species of concern are: Burdock Reed Canary Grass Canada Thistle Spotted Knapweed
Human-Wildlife Interaction	Risk to people and bears exists due to spawning concentrations of kokanee in Meadow Creek spawning channel and other local streams Grizzly bear are at risk to poaching during spring Elk and deer may also be subject to illegal harvest Disturbance/removal of Painted turtles at nest sites
Water Flow/Level Management	River channel erosion could de-water wetlands Recruitment of Cottonwoods reduced Loss of grass/forb areas near high water mark at head of Kootenay Lake

Threats	Description
Mosquito Control	Treatments may affect amphibian development, bat and songbird foraging; specific impacts are not well known.
Agricultural Land Management	Agricultural practices can impact ground nesting birds, such as bobolink. Adverse impact on habitat diversity and biodiversity due to monoculture of non-native vegetation communities Invasive plants can establish on agricultural fields Haying/mowing can have positive effects on spring range for ungulates
Wildfire and Disturbance History	Wildfire could reduce cover of mature and old forest along with wildlife trees and coarse woody debris structural elements; increase risk of invasive plants, threaten community. Legacy of logging, road building and clearing has reduced old forest area and habitat elements.

Threats were assessed using standard criteria (CMP 2007; Table 7), based on knowledge of the properties gained through fieldwork, public feedback, and a review of available information. The severity of the threats differs significantly among the targets (Table 8). From a habitat/ecosystem perspective, non-forested habitats have consistently high threat ratings, due to persistent and considerable risks from invasive plants, motorized access, water flow/level management, agricultural land management. Threat ratings for painted turtle reflect risks from motorized access, invasive plants and water flow/level management. Ratings provide the basis for proposed actions, aimed at reducing threats to the biodiversity targets. The action table (Table 9), outlines specific tasks, budgets, timelines and relative priorities to address threats to plan biodiversity targets,

Table 7: Threat rating criteria (CMP 2007) used to assess the impact of threats on biodiversity targets defined for the Lower Duncan River Conservation properties.

	Very High	High	Medium	Low	Positive
Scope – The proportion of the target that can reasonably be expected to be affected by the threat within ten years, given the continuation of current circumstances and trends.	71-100%	31-70%	11-30%	1-10%	+ effect on target
Severity – Within the scope, the level of damage to the target from the threat that can reasonably be expected given the continuation of current circumstances and trends.	71-100%	31-70%	11-30%	1-10%	
Irreversibility – the degree to which the effects of a threat can be reversed and the target affected by the threat restored.	Unlikely and/or >100 years	Not practically affordable and/or 21-100 years	Reversible with reasonable commitment and/or 6-20 years	Easily reversible and/or 0-5 years	

Table 8: Summary of threat ratings by biodiversity targets for the Lower Duncan River Conservation properties. Threat ratings follow Open Standards for Conservation (CMP 2007).

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Threats	Forest Habitat	Non Forest Habitat	Elk	Grizzly Bear	Bobolink	W. Painted Turtle	Waterfowl	Kokanee	Summary Threat Rating
Motorized Access	Med	High	High	High	High	V High	Low	Low	High
Invasive Plants	Med	V High	Med	Med	Med	V High	Med	Low	High
Human-Wildlife Interaction	-	-	Low	High	Low	Med	Low	Low	Med
Water Flow/Level Management	Med	High	Low	Low	Med	High	High	Low	Med
Mosquito Control	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Agricultural Land Management	-	High	Positive	Low	High	Low	Positive	Low	Med
Wildfire and Disturbance History	High	Low	Positive	Low	Med	Low	Low	Low	Low
Summary	Med	High	Low	Med	Med	High	Low	Low	

Table 9: Proposed Land Management Actions and Priorities

Target	Threat	Action #	Action	Candidate Locations	Polygons	Priority	Timeframe/Duration	Cost	Comments
All Targets	Motorized Access	1	Implement Access Management Plan (gating, signage, closures)	All		H	Year 1	3,000	
	Invasive Plants	2	Invasive plant inventory and properties-wide plan to compliment ongoing work	All		H	Year 1	3,000	
Forest Habitat	Invasive Plants	3	Reduce invasive plant (Burdock) cover and vigour	DL 570, 896, 881	148, 64, 50	M	Annually	4,000	Control Measures Uncertain
	Fire and Disturbance History	4	Develop Service agreement with SE Fire Center to protect forest habitat	All		H	Year 1	Est of $2/ha/yr	TNT Property
		5	Recruit old forest attributes via wildlife tree creation	DL 570,896,881,12852,16024	64, 62, 50, 53	L	Year 2-5	2,500	One-time cost
Non Forest Habitat	Invasive Plants	6	Reduce invasive plant (Canada thistle) cover and vigour	DL 570, 896, 881, 7450, 12852	15, 148, 33, 92, 3, 1, 7, 4	VH	Annually	5,000	Ongoing, effective
	Water Flow/Level	7	Create/enhance wetlands	DL 881, 7450	90, 91, 151	M	Year 3-5	15,000	Scoping required
		8a	Restore riparian vegetation along the Duncan River and tributaries	DL 881, 7450, 8895	4, 15, 92, 33	H	Year 1-3	10,000	Prescriptions
		8b	Maintain/restore grass/forb habitat in areas impacted by reduced flooding disturbance	DL 16024, 896	114, 117	M	Annually	7,500	Costly per hectare
	Mosquito Control	9	Identify sites to be excluded from Bt program	All		M	Year 2	5,000	Review risks
	Agriculture Land Man	10	Convert field habitat to native vegetation (shrub/forest) outside of ungulate spring forage areas	DL 570, 881, 7450,12852	13, 92, 15, 7, 4, 148, 3	H	Year 1-10	5,000	
Elk	Invasive Plants	6	Reduce invasive plant (Canada thistle) cover and vigour	As Identified in #6	15, 148, 33, 92, 3, 1, 7, 4	M	Annually	included in #6	
	Motorized Access	1	As identified in access mgmt plan	All		H	Year 1	included in # 1	
	Agriculture Land Man	11	Mow or burn old field sites to produce early spring forage in conjunction with Action #6	DL 570, 896, 881, 7450, 12852	1, 3, 4, 7, 15	M	Annually	included in #6	Clarify sites in conjunction with 9a
Grizzly Bear	Invasive Plants	6	Reduce invasive plant (Canada thistle) cover and vigour	DL 881, 879/880	15, 87, 51, 52	M	Annually	included in #6	
	Motorized Access	1	As identified in access mgmt plan	All		H	Year 1	included in # 1	
	Human-Wildlife Interaction	12	Reduce bear-human conflicts through managing attractants	All		H	Annually	10,000	Separate Funding
		13	Reduce bear-human conflict through aversive conditioning of bears	All		M	as needed	25,000	Separate Funding
		14	Identify movement corridors and map current habitat use during spring	DL 881, 570, 896/879, 880, 8895		H	Year 1	3,000	Compile existing info
		15	Enhance/protect spring feeding areas	As identified in #14		M	Year 4-5	Unknown	
	Water Flow/Level	8a	Restore riparian vegetation to benefit bears along the Duncan River and tributaries	DL 881,7450, 8895	4, 15, 92, 33	L	Year 1-3	included in #8b	
	Wildfire	16	Assess berry production potential in uplands	DL 881	25, 26, 49	L	Year 5	3,000	
Bobolink	Invasive Plants	6	Reduce invasive plant (Canada thistle) cover and vigour	DL 881	15	M	Annually	included in #6	
	Mosquito Control	9	Identify sites to be excluded from Bt program	DL 881	15	L	Year 2	included in #9	
	Agriculture Land Man	17	Maintain unmanaged field component of ag lands in conjunction with #6 & 8a	DL 881	15	H	Annually	N/A	
		18	Conduct periodic inventory of bobolink population	DL 881	15	L	Every 5 years	1,000	
Painted Turtle	Invasive Plants	19	Remove invasive plants and monitor currents nesting use on enhanced nesting area	DL 1884	56	VH	Annually	1,500	
	Human-Wildlife Interaction	20	Improve nesting area by bringing in more nesting material	DL 1884	56	M	Year 1	1,500	
		21	Identify use and enhancement potential on Lake Property	DL 7450	151, 4	M	Year 1-3	1,000	
	Water Flow/Level	22	Investigate ways to maintain water levels at Argenta Slough	DL 1884	56	H	Year 2	5,000	
	Mosquito Control	9	Identify sites to be excluded from Bt program	DL 1884, 7450	151, 4, 56	L	Year 1-3	included in #9	
	Agriculture Land Man	8a	Restore riparian vegetation along the Duncan River and tributaries	DL 7450	151, 4	L	Year 1-3	included in #8a	
Waterfowl	Water Flow/Level	8b	Maintain/restore grass/forb habitat in areas impacted by reduced flooding disturbance	DL 16024, 896	114, 117	M	Annually	included in #8b	Costly per hectare
		7	Create/enhance wetlands	DL 881, 7450	90, 91, 151	M	Year 3-5	included in #7	Scoping required
Kokanee	Invasive Plants	6	Reduce invasive plant (Canada thistle) cover and vigour	DL 879/880	87	L	Annually	included in #6	
	Agriculture Land Man	8a	Restore riparian vegetation along Meadow Creek and John Cr	DL 881	92, 15	L	Year 1-3	included in #8	
Other	Knowledge Gap	23	Inventory Sp @ risk - Olive-sided flycatcher; Barn swallow, Western toad	All	All	M	Year 2-5	5,000	

4.1 Access Management

From a conservation and human use perspective, access management principles and details are key elements of this plan. An access management plan (Appendix 4) has been developed in accordance with these principles:

1) Public use and enjoyment is supported
2) Hunting access is supported where safe to do so
3) Motorized access is supported on gazetted roads only
4) Where conservation and access issues conflict, conservation values come first

Access management actions include gating (6 sites) and signage (multiple locations) to clearly establish and guide appropriate use on the Lower Duncan River Conservation properties.

4.2 Agricultural Land Management

Nearly 100 ha of old agricultural fields are present on the Lower Duncan River Conservation properties. These sites are a focal point for many current land management actions – invasive plant control; elk forage production; bobolink nesting, as well as hay production. In the future, restoring native shrub, riparian forest habitat, and wetland habitat to a portion of these sites is an important goal. Appendix 10 shows the proposed locations for shrub/riparian habitat restoration; continued mowing for thistle control, as well as hay production. Where cost recovery can reasonably be expected from actions (e.g. hay production), no-cost opportunities will be offered to local groups.

4.3 Use of Property Improvements

The Nature Trust's Lake Ranch property (DL 12852) includes 2 residences that were associated with the original farm. The Nature Trust intends to continue renting the houses under a lease agreement with the current or other suitable tenants. Use or dismantling of the other farm out-buildings, which include one mechanic shop, one insulated vegetable storage building, one covered hay shed and one loafing shed, will be determined on a case-by-case basis in concert with the long-term management objectives of the property.

4.4 Archaeological Assessment

Seven pre-contact archeological sites and three isolated finds have been recorded as part of both pre-and post-Duncan Dam reconnaissance-level archeological assessments (i.e., east and west side of the lake on present-day beaches, ground stone artifacts, including pestles, above the west shore of the reservoir near Howser). The surrounding provincial forest lands have recently been mapped for archeological potential, with DL 881 being captured by archeological potential polygons K26-32 and 33. Four zones of archeological potential have been identified and mapped in the Lower Duncan River (Choquette 2009; Appendix 5). A qualified archeologist should investigate any proposed

disturbances to mineral soil disturbances exceeding 50 cm in depth and/or on elevated areas such as banks of present or relict watercourses, plus ridges, knolls, fans and particularly rock faces in Zones 1, 3 and 4, and vehicle and machine movements should be restricted to existing access in Zone 2 (Choquette 2009).

4.5 Fire Management Plan

Robert Mitchell (2009) prepared and submitted to FWCP and TNT a fire management plan (Appendix 6). The plan identifies the organizations responsible for the development of a Fire Prevention and Control Plan, and recommendations for treatment priorities.

4.6 Historic Review of Duncan-Lardeau Public Advisory Committee

Brenda Herbison (2009; Appendix 7) prepared an historic perspective of Duncan-Lardeau Public Advisory Committee (DLPAC). The report summarized policy and management positions made on the Duncan-Lardeau flats from 1979 to 1999. The DLPAC has not met since 2003; however there is interest in re-establishing an advisory group to provide input on actions (see 4.7).

4.7 Public Input

A resource stewardship sense of community has prevailed over the land and resources of the Lower Duncan-Lardeau valleys for nearly a half century. Appendix 2 contains a summary of responses received to the questionnaire from the public Open House held on May 21, 2009 at the Meadow Creek Hall; key points are listed below.

The vast majority of respondents that attended the open house session rated the properties as having either *extremely significant* (67%), *significant* (28%) or *moderately high* (5%) conservation values for the Duncan-Lardeau area.
The three top priority issues identified by the public were:

- biodiversity conservation (often associated with fish and wildlife conservation)
- access management; and,
- community participation/public involvement

5.0 Effectiveness Monitoring and Evaluation

The purpose of the effectiveness monitoring and evaluation program is to evaluate the success of management decisions and actions on addressing threats to the property-specific biodiversity targets. Nine monitoring indicators, listed in Table 5, will form the

basis for evaluation. These indicators can be readily tracked on an annual basis, and will form the foundation for progress reporting in 5 years time (2018).

6.0 Recommendations

1. High Priority actions from Action Plan (Table 9) should be implemented:
    - invasive plant inventory and plan to compliment ongoing work
    - access management plan implementation (gates & signage)
    - habitat restoration on suitable portions of agricultural fields
    - TNT to develop "Service Agreement" with SE Fire Control Centre (MFLNRO) to clarify wildfire control roles and responsibilities.
    - ongoing operations to limit and reduce thistle continue thru an agreement with local groups

2. Inventory of provincial species-at-risk and local species-of-interest (barn swallow, olive-sided flycatcher, western toad)

3. Investigate process to establish conservation covenants or notations of interest for crown lots (DL's 1549, 257) that have been incorporated into current plan, as well as covenant potential on crown foreshore, crown floodplain, and on BC Hydro property downstream of Duncan Dam (DL 882).

4. A regional ad-hoc Advisory Committee has been convening over the past few years. This committee has provided general input to the development of the draft management plan. It is recommended that an Open House be held every 2 to 3 years in Meadow Creek to update community on actions completed and outline future actions. This event should be held in conjunction with other initiatives in the area such as WildsafeBC and Friends of the Lardeau River and the ad-hoc Advisory Committee should be invited.

5. An annual budget proposal should be prepared for submission to FWCP, TNT, and other potential funding sources. Implementing this plan will require approximately $46K in year 1 for base operations and project costs. Ongoing base operations will require at least $25K/yr in future years. Bear Smart and Bear Aversive conditioning initiatives are not included in these totals, as they are funded separately. Co-operative funding and co-ordination with the Invasive Plant Committee, CBT, and RDCK would be beneficial. Implementing habitat restoration prescriptions will require stand-alone project budgets that will decrease following establishment of target vegetation communities.

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Appendix 1: Operational activities from 1999 Duncan Properties Wildlife Management Plan

Poole et al. (1999), developed the *Duncan Properties Wildlife Management Plan* for the then nine parcels of land (544 ha) in the lower Duncan River valley. Eighteen management recommendations were made within the context of being consistent with regional policies of retaining landscape connectivity, mature and old growth forest consistent with ungulate winter range and old growth biodiversity guidelines.

Of the 18 wildlife management recommendations made, all but three activities were acted upon. Enhancing old forests through trial studies involving topping or girdling of mature trees was not initiated (Medium priority); there was no slashing of shrubs in DL 257 (Low priority); and there were issues surrounding gating proposed for DL 257/DL 8895. No direct management action was taken with respect to allowing most mature forests on the properties to age undisturbed to promote old growth forests. The following table provides an implementation status summary of the 1999 wildlife management plan recommendations.

Property-specific Strategic Management Recommendations and Priorities (Poole et al 1999)			**Implementation Status**	
Property	**Activity**	**Priority**	**Activity**	**Date**
DL's 879 & 880	Brush trails and widen roads for wildlife viewing	**M**	Trail have been brushed for fish viewing	2003
	Signage advertising wildlife viewing opportunities for spawning channel and Gerrard rainbows at Trout Lake	**M**	Interpretative signs for the spawning channel were set up; however; signs are for fish, not wildlife	2003
DL 881	Encourage trail use on existing small roads	**M**	To date FWCP haven't encouraged use on this property	
	Seed hillside roads with a landing mix (clover, redtop, and orchard grass) to reduce spread of weeds and provide erosion control	**H**	Spur roads were deactivated and seeded along with the landing. Debris at landings were cleaned up and burned	2001
	Remove decked logs from riparian areas on DL 881 and redistribute elsewhere as coarse woody debris	**H**	Riparian areas were cleaned up and debris was piled and burned	2000
	Hay fields once per year in August to enhance	**H**	Ongoing	Started in 2000

Property-specific Strategic Management Recommendations and Priorities (Poole et al 1999)			Implementation Status	
Property	**Activity**	**Priority**	**Activity**	**Date**
	early spring ungulate forage production			
	remove, reposition fences	**H**	Done	2000
	reduce thistle in lower field	**M**	Ongoing	Started in 2000
DL 257	Slash shrubs to enhance ungulate forage production; 2 ha/yr over 2 years. Review results every 5 yrs.	**L**	No slashing on DL 257	
	Gate roads	**H**	Gating was investigated but road provides access to private land to the south and was not supported by land owner. Gate at Cooper Creek Cedar mill site blocks "circle tour" access	
	expand topping/girdling depending on results from experimental trials on DL's 570 & 896	**M**	No experimental trials initiated.	
DL 8895	expand topping/girdling depending on results from experimental trials on DL's 570 & 896	**M**	No experimental trials initiated	
	Gate road	**H**	See comments DL 257	
	Restore gravel pit	**M**	Northern portion was restored (top soil redistributed and grass seeded). Property boundaries unclear in the southern portion of the gravel pit	2008
	Encourage trail use	**M**	Not promoted (i.e., ATV issues)	
DL 1549	expand topping/girdling depending on results from experimental trials on DL's 570 & 896	**M**	No experimental trials initiated	
DL 570	Remove thistle	**H**	Ongoing : Mowing of heavy concentrations annually	2000-2011
	Remove fences	**M**	Done	2000
	Monitor nest boxes that were erected: 2-3 visits in May & early June Evaluate success for future nest box program	**L**	Monitoring over 1-2 years: no use found.	2001-2002
	Enhance ungulate winter forage on existing logged blocks (1982-3) by slashing decadent shrubs and thinning edges from conifer encroachment	**M**	The logged blocks were not slashed – focus shifted to restoring to conifer/deciduous mix. Regeneration surveys completed in 2006 showed that blocks are coming along fairly well. A few areas may benefit from planting.	

Property-specific Strategic Management Recommendations and Priorities (Poole et al 1999)			Implementation Status	
Property	**Activity**	**Priority**	**Activity**	**Date**
	Re-establish interpretative sign and provide map of trail network on DL 570	**M**	Interpretative sign completed; however, focus was on all conservation properties. No trail network map.	2000
	Trial area for topping or girdling of mature trees in 2-3 ha area to promote snag production (DL 570 and 896 identified as experimental trial areas). If successful, application to DL's 1549, 8895 and 257)	**M**	Not initiated	
DL 896	Remove thistle	**H**	Ongoing : Mowing of heavy concentrations annually	2000-2011
	Remove fences	**M**	Done	2000
	Trial area for topping or girdling of mature trees in 2-3 ha area to promote snag production (DL 570 and 896 identified as experimental trial areas). If successful, application to DL's 1549, 8895 and 257)	**M**	No experimental trials initiated	
	Slash brush to increase ungulate forage (cottonwood and willow encroachment) at 5ha/yr for 4 years Review re-growth	**H**	Ongoing but reduced scale aiming at ~2 ha/year over DL 570/896/16024	2004, 2008
	Monitor nest boxes that were erected: 2-3 visits in May & early June Evaluate success for future nest box program	**L**	A pine marten was observed in next box in Nov. 1998. Monitoring over 1-2 years: no other use found.	
DL 16024	Slash brush to increase ungulate forage (cottonwood and willow encroachment) at 5ha/yr for 4 years Review regrowth		Ongoing but reduced scale aiming at ~2 ha/year over DL 570/896/16024	2007, 2009-2011 proposed
	Monitor nest boxes that were erected: 2-3 visits in May & early June Evaluate success for future nest box program	**L**	Monitoring over 1-2 years: no use found.	
DL 1884	Enhance nesting opportunities for Painted turtles	**H**	Nest material (gravel) dumped at nest site and vehicle protection of nests	1997

Property-specific Strategic Management Recommendations and Priorities (Poole et al 1999)			Implementation Status	
Property	**Activity**	**Priority**	**Activity**	**Date**
			Herbison, B. 1999. Painted turtles in the Duncan-Lardeau flats wildlife area. FWCP, Nelson, BC	1999
	Wildlife viewing of Painted turtles at Argenta Slough	**M**	2 loafing logs placed in slough	2002
All properties	Most mature forest on properties be allow to age undisturbed to promote old growth forests	**M**	No management action	

Priority wildlife, habitat and management issues and local activities completed 1999 to 2011

Priority Management Issues and Concerns		Activities Completed	Year
Species at Risk (SAR)	Western Grebe – *Red-listed* (R)		
	Northern Leopard frog (R)		
	Rubber boa –*Yellow-listed* (Y)		
	American bittern (B)		
	Great blue heron (B)	Lower Duncan surveyed one year as part of Machmer, M.M., and Steeger, C. 2003. Great Blue Heron Breeding Inventory and Habitat Assessment in the Columbia Basin. FWCP, Nelson, BC	2003
	Lewis' woodpecker (B)		
	Bobolink (B)	Annual monitoring (G. Spitler), Lot 881 fields	2000-07
	Vaux Swift	Nest box installation and monitoring on DL 570	2009-present
	Painted turtle (B)	Annual monitoring of nesting activity, loafing numbers	ongoing
	Townsend's big eared bat (B)	West Kootenay Townsend's Big-eared bat project (Radio-transmitter study, geological assessments of maternity roosts, roost microclimate data) Hill, T, A. Reid, R. Clarke, J. Krebs and J. Gwilliam. 2006. West Kootenay Townsend's Big-eared bat (Corynorhinus townsendii) project. Prepared for FWCP, Nelson, BC.	2006
	Wolverine (B)		
	Grizzly bear (B)	Bear Smart program to reduce human-bear conflict Saunders, G. 2010. North Kootenay Bear Smart Program Annual Report. Prepared for FWCP, CBT, RDCK. Nelson, BC	2009-2011
		2010-11 Less-lethal management of bears near the Meadow Creek Spawning Channel	2010-2011
	Small spike-rush		
	Regel's rush		
	Eurasian water-milfoil		
Regional Priorities	Ungulate winter range	Davidson, P. W. 2005. Lower Duncan Elk Enhancement	2005

Priority Management Issues and Concerns		Activities Completed	Year
		Plan. Prepared for Kootenay Chapter of the Elk Foundation	
		Poole, K.G. and B. Park. 2003. Elk habitat use and movement patterns in the Lardeau valley, West Kootenay, 1998-2002, final report. Prepared for Meadow Creek Cedar	2003
	OGMAs	Herbison. 2006. Conifer restoration on the Duncan-Lardeau flats wildlife properties. FWCP, Nelson, BC.	2006
		Holt, R.F. and D. MacKillop. 2006. Endangered forests of the Inland Rainforest: An inventory of old-growth in Trout Lake and the Incomappleux. Forest Ethics and FWCP, Nelson, BC	2006
	Connectivity	On-going property purchases by FWCP and TNT (DL 12852 and DL7450)	2007
		Herbison, B. 2008 Wildlife and Conservation Priorities along the Lardeau River corridor. Prepared for Fish and Wildlife Compensation Program, Nelson, B.C.	2008
	Protected Areas Strategy: Goal 2	In 2002, the Lardeau River and northern Kootenay Lake riparian ecosystems were approved by the Kootenay-Boundary Interagency Management Committee to be included on the 'A list' of 22 candidate areas for protection under provincial Protected Areas Strategy Goal 2.	2002
Other	Stewardship program for private lands Provide tangible benefits to local people	Weed control, slashing, haying, tree planting completed by local and regional contractors	Ongoing
	Habitat Assessments	Herbison, B. 2000. Assessment of shrub enhancement possibilities on the Duncan-Lardeau flats. Unpublished report for Columbia Basin Fish and Wildlife Compensation Program, Nelson, BC.	2000
		Herbison, B. 2007. Review of water-level management	2007

Priority Management Issues and Concerns	Activities Completed	Year
	options for the Argenta Slough. Unpublished report prepared for the FWCP. Nelson, BC.	
Duncan Dam Water Use Planning	In 2009, a 10-year, bi-annual wildlife monitoring program along the lower Lardeau and the lower Duncan Rivers began under BC Hydro's Duncan Dam Water Use Plan (DDMON#14)	2009
Mosquito study	Meeting with locals to discuss mosquito control program on TNT properties. Decision deferred until management plan completed	On-going
	Jackson, M., J. Bull and C. Phelan. 2002. The influence of the Duncan Dam on the mosquito populations of the Lower Duncan Floodplain. Prepared for The Duncan Water Use Plan Consultative Committee, Castlegar, BC.	2002
Property purchase	TNT purchased Lake property	2007

Appendix 2: Summary of response to Public Open House questionnaire.

Q #1: On a scale of 1-6 how significant do you think the conservation of the properties are for the Duncan Lardeau Area? (1= no significance…….6=extreme significance)

The vast majority of respondents that attended the open house session rated the properties as having either *extremely significant* (67%), *significant* (28%) or *moderately high* (5%) conservation values for the Duncan Lardeau area.

Q #2: When you think about management of the conservation properties, what are the three most pressing issues that should be considered?

In evaluating and prioritizing management issues it was necessary to acknowledge that opinions and comments submitted varied as to what constituted the focus, threat or risk related to the broad categories listed in the questionnaire. For example, the access issue stimulated responses for open public access for recreation to property-specific restrictions for hunting to full vehicular and hunting closures on all the properties. Concern was also expressed over increased use of motorized watercraft on rivers and wetlands.

Based on written response from the open house, the three top priority issues to be considered in management of the properties are:

- biodiversity conservation (often associated with fish and wildlife conservation)
- access (from full open access to some recreation-related access restrictions to no motorized access); and,
- community participation/public involvement

The other issues identified in descending order of importance by open house participants responding via the questionnaire are:

- hunting and fishing opportunities (limited to full restrictions for hunting)
- mosquito control (full support, control within ecological limits and opposition to any control measures)
- fish and wildlife conservation (often associated with biodiversity conservation)
- grassland for deer and elk (often associated with agriculture activities, prescribed burning)
- invasive plant controls
- agricultural land management (associated with ungulate winter range, socio-economic benefits to the community, historic land use)
- forest management (support on limited scale to meet biodiversity objectives)
- opposition to hydro-electric developments
- motorized boat restriction on rivers and wetlands needed

- continue property purchases

Q #3: Do you have any comments regarding the management of the Duncan Lardeau Conservation Properties?

This question was general in purpose, with correspondingly contrasting responses. Current management was generally considered satisfactory (i.e., the proposed plan looks good, informative and an important step). Some expressed concern that they did not know about the plan to comment and suggested there was much information and some misinformation. For examples the properties have been studied to the point of neglect; FWCP priorities may be tainted by vocal special interests; access for all hunting, fishing, hiking, camping versus other expressions that the property should be maintained as a wildlife refuge with no motorized recreation.

Q #4: Do you support the idea of an Advisory Committee to help implement the Land Management Plan, and if so, how should it be structured?

Seventy-seven percent of respondents favoured some form of public advisory group; however, contrasting views were expressed as to committee or group representation and size, committee terms of reference, and final decision-making authority. It was suggested that:

- the committee or group consist of appropriate scientists, local people, other stakeholders, environmental organization, BC Wildlife Federation
- large enough to represent the range of issues and small enough to be functional
- decisions should ultimately rest with agencies owning the properties…'advisory committee can be the sounding board'

Of the 10% opposed, concern was greatest over 'vested interests likely to poison Advisory Committee' and 'better to consult the many than to let a few control…'. A total of 13% of respondents were undecided.

Q #5: Would you like to receive a copy to the Land Management Plan once completed?

Over 95% of open house questionnaire respondents wish to receive a copy of the plan once completed.

Appendix 3: 2011 Lower Duncan River Conservation Area Structural Stage Definitions (modified from Poole 1999)

Agricultural Lands

Land that is or has been in the recent past used for agricultural purposes. These areas were delineated from evidence of plowing, haying, and/or fence lines.

Early Seral Forest Communities

Early seral communities were characterized as stand initiation forest communities (clearcuts). We believe that these stands were generally age class 1 and 2 (1 to 40 years old). Such communities were characterized by a lack of overstory cover and dominance by tree regeneration, shrubs or herbaceous vegetation typically less than 2 meters. The main difference between the stand initiation and shrub communities is that natural succession will lead to dominance by trees with time in this class.

Grass/Forb Communities

Grass/forb communities were characterized by dominance by herbaceous vegetation but not used for agricultural purposes. Absence of tree or shrub cover and presence of low (less than 2 meters) herbaceous vegetation that appears lighter than both tree and shrub cover were characteristics we used to identify grass/forb communities on aerial photos.

Sand Bar

Areas devoid of vegetation due to seasonal lake or river flooding.

Immature Forest

Immature stands were typically characterized by the presence of age class 2 to 4 (21 to 80 year old) trees, tree height (shorter trees compared to older stands), and tree color (lighter shade of gray compared to older stands). Such areas tended to have less vertical complexity than older stands. Spatial patchiness was generally low in this class.

Mature Forest

Mature forest were identified by the following characteristics: presence of age class 5 to 7 (81 to 140 year old) trees, tree height (taller trees compared to younger stands), and tree color (darker colors compared to younger stands). Such areas tended to have higher vertical and horizontal diversity than immature stands but less vertical and horizontal diversity than old forest stands.

Old/mature Forest

The old/mature forest category as a broad category to describe forest types which exhibit distinctly different structural characteristics than younger stands. Characteristics include low densities of larger trees, presence of large dead trees and logs, tree gaps and spatial patchiness, and vertical canopy complexity. Other conditions that may be found in old/mature forests include many stages of decomposition, multiple tree species present and distinctive crowns in the upper canopy. Crown closure is usually less than 100 percent.

Riparian/Wetland Communities

Riparian or wetland communities apply to areas where the ground is temporarily, seasonally or permanently wet and is occupied by water-loving or water-tolerant vegetation such as cattails, sedges, or willows.

Rural Residential/Industrial

Cleared land that is not being used for agricultural purposes.

Shrub Communities

Shrub communities were identified by the absence of tree cover and the presence of deciduous or evergreen shrubs ranging from 0 to 10 meters in height. Features used to identify shrub communities on photos include reflectance values between those of trees (dark) and rock (light), height ranging from 0 to 10 meters and round crown shape.

Measures	Status/Type	Location	Action	Rationale	Priority	Cost	Comments
Gating	Current	DL 570/Highway 31	Monitor	Gate Locked in summer 2011. Monitor compliance.	H	Nil	Recent ATV activity going around gate - may need to action(block) in future
		DL 881/Highway 31	Monitor	Vehicle access to ag field and wetlands will degrade sites	H	Nil	Rope across entrance. Monitor compliance and determine if a more permanent gate/lock is required
		DL 881 Back Channel	Monitor	Invasive plants, dumping, wildlife disturbance	H	Nil	Cable across start of road. Monitor compliance and determine if a more permanent gate/lock is required
	Candidate	DL 881/Lower Duncan R	Gate at DL 881/257 Property Boundary	Spread of weeds/dumping of cars and appliances	M	$3,000	Little justification for vehicle access - dead end road. Visitors can walk. Similar to DL 570 gate
		Upper DL 881/Highway 31	Monitor	Road used for Springer Cr FP/SEFC access	L	Nil	Consider gate in future if necessary
		DL 881 Bench/Meadow Mtn	Monitor	Road used for Springer Cr FP/SEFC access	L	Nil	Consider gate in future if necessary
		DL 881 Homesite	Gate both access points	Road is not required. Potential for dumping of vehicles and appliances	L	$2,000	Present access to DL 257 is from MOT gravel pit
		DL 12852 North Field	Gate at Interpretative Sign Location	Prevent vehicle and ATV access	M	$600	Gate in association with pole fenced area for parking access. May need to consider fencing along east boundary to prevent livestock from accessing property
		DL 12852 Homesite	Gate both access points to buildings	Renters of homes privacy	L	$600	Monitor and only consider if necessary
Signage	Interpretative	DL 570/Highway 31	Update	To reflect revised Man Plan and acquisition of 12852/7450	H	$1,000	Map outdated
		DL 881/Highway 31	Signage	To reflect revised Man Plan and acquisition of 12852/7450	H	$1,000	Kiosk in place
		DL 12852/Argenta Rd	Signage	To reflect revised Man Plan and acquisition of 12852/7450	H	$1,000	Kiosk in place
		DL 1884	Signage	To reflect property boundary, ownership, hunting closure	H	$1,500	
	Regulatory	DL 881 Back Channel	Monitor	Ensure compliance	H	Nil	"No unauthorized vehicle Access" - associated with current gate
		DL 570/Highway 31	Update	Existing signage old and weathered	M	$100	
		DL 881/Highway 31	Signage	Signage in conjunction with gating	H	$100	Similar to DL 570/Highway 31
		DL 12852 North Field	Signage	Signage in conjunction with gating	H	$100	Similar to DL 570/Highway 31
Closures	Shooting	DL 12852/7450	Bow Hunting Only	Private residences close by	H	Nil	Investigate including in hunting regs.
		DL 881(field portion close to private property)	Monitor	Private residences close by	H	Nil	May want to consider bow hunting only - need to consult with neighbouring residents.
	Hunting	DL 1884	Signage	Existing Closure in hunting regs		$100	There was signage at one time put up by MoE
		DL 570/896/16024/881(all or part)	None	Hunting allowed		Nil	

Appendix 5: Archeological Overview Assessment and Stewardship Plan for the Lower Duncan Conservation Property Complex

ARCHAEOLOGICAL OVERVIEW ASSESSMENT

AND STEWARDSHIP PLAN FOR

THE LOWER DUNCAN CONSERVATION PROPERTY COMPLEX

prepared for
Fish and Wildlife Compensation Program
The Nature Trust
Nanuq Consulting Ltd.

by
Wayne T. Choquette
Archaeologist

Management Summary

An Archaeological Overview Assessment of the Lower Duncan Conservation property Complex was prepared in support of a Strategic Management Plan to facilitate achieving the Nature Trust (TNT) and Fish & Wildlife Compensation Program (FWCP) goal of ecosystem-based strategic management. Four general landscape-based archaeological stewardship zones were defined, based primarily on surficial geology and hydrology, within which certain types of archaeological values and evidence may occur.

Zone 1 encompasses the broad depositional plain on the floor of the Purcell Trench, previously inundated by ancestral Kootenay Lake and later by the combined floodwaters of the Duncan and Lardeau rivers and Meadow, Cooper and Hamill creeks. Zone 2 comprises the terrace complex of the Cooper Creek delta-fan in DL 570 while Zone 3 consists of two previously mapped archaeological potential polygons in DL 881. Zone 4 includes steep bedrock cliffs in western DL 881 and DL 570.

With regard to archaeological heritage conservation, the characteristics of these zones lend themselves to specific constraints on future land uses which would involve disturbance of the mineral soil. These are encapsulated in the following recommendations:

In all zones, movements of machinery should be restricted to existing access infrastructure wherever possible; and

The presence of culturally modified trees to be determined by field survey.

In Zone 1, it is recommended that any proposed excavations or other *disturbances of the mineral soil of the level floodplain exceeding 50 cm in depth should be accompanied by archaeological monitoring* and stratigraphic recording; and

It is recommended that any proposed excavations or other *disturbances of intact mineral soil on elevated areas such as the banks of present or relict watercourses plus ridges and knolls should be reviewed by a qualified archaeologist* with the provision for relocation onto existing disturbances avoidance or more intensive archaeological investigation, depending upon individual circumstances.

In Zone 2, level areas within 30 m of terrace margins should be machine-free and no additional bladed structures should be built without more intensive prior archaeological investigation. Random surface movements of light machines are permissible across terrace interiors beyond the 30 m buffers; and

Slash should not be burnt directly atop any level areas; use of a sloop set on an existing disturbed area is recommended if material is to be burnt onsite.

In Zone 3 within the areas captured by archaeological potential polygons K26-32 and 33, use of existing access and disturbed areas such as landings is recommended, including for use of burning sloops. Any proposed actions that might cause disruption of intact mineral soil such as additional bladed structures, trenching or scarification should be preceded by more intensive archaeological investigation; and

Burn piles should be situated on slopes and not directly atop any level areas or the crests of ridges and knolls.

In Zone 4, the locations of any proposed major disturbances of mineral soil or rock faces should be reviewed by a qualified archaeologist with the provision for avoidance by relocation or more intensive archaeological investigation, depending upon individual circumstances.

1. Introduction

The Lower Duncan Strategic Management Plan is intended to facilitate achieving the Nature Trust (TNT) and Fish & Wildlife Compensation Program (FWCP) goal of ecosystem-based strategic management of the Lower Duncan conservation properties. This area is known to contain high natural and cultural heritage values which could be affected by activities associated with restoration and enhancement. This report was prepared in response to the need for ensuring that no disturbance of significant archaeological values takes place. As such, it comprises an Archaeological Overview Assessment (AOA) of the subject properties in the context of future ecosystem management.

This report summarizes the background information pertaining to the environmental and cultural setting of the subject properties, describes the methods employed and presents the results of the assessment. The report concludes with a discussion of archaeological stewardship of identified locations of archaeological concern with recommendations regarding actions that can be taken to achieve conservation of archaeological values in the context of the proposed ecosystem-based strategic management.

2. Study Area Environmental Background

The subject properties are situated in the Purcell Trench, a large north-south valley that separates the Selkirk and Purcell Mountains in southeastern British Columbia. They occupy an area between Duncan and Kootenay lakes which coincidentally contains the confluences of the Duncan River with the Lardeau River and Meadow, Cooper and Hamill creeks. Most of the area comprises an extensive nearly level plain of alluvial and lacustrine sediments.

2.1 Geology and Palaeohydrology

The surrounding terrain was produced by several episodes of mountain building accompanied by the emplacement of granitic intrusions and the warping, fracture and uplift of sedimentary rocks (Reesor 1996). The bedrock in the immediate vicinity consists of north-south striking Cambrian to early Mesozoic quartzite, calcite marble, dolomite, greenstone, amphibolite and phyllite of the Hamill and Lardeau Groups and the Badshot-Mohican Formation. Some time before 70 million years ago, the Purcell Trench itself was formed by downfaulting that created a north-south trough which developed further as an erosional form during the Tertiary.

This area was extensively glaciated during the Pleistocene Epoch of the last few million years, although evidence of only the most recent glacial activity has been recognized at the present time. The most extensive advance comprised a coalescent ice sheet that covered all but the highest peaks. The Purcell Trench was subsequently occupied by a large trunk glacier that covered the entire study area and advanced well south of the present International Boundary after 25,480 + 320 B.P. (Fulton 1971). Final deglaciation is suggested to have commenced about 15,000 years ago (Ryder 1981); parts of the upper Columbia River drainage became ice-free sooner than areas further west (Choquette 1996). Higher elevations apparently became ice-free first (Clague 1989), while melting ice blocks lingered at some places in the valley bottoms. The large deep

lakes that now characterize the upper Columbia drainage, such as Kootenay, Trout and Duncan, occupy the basins previously occupied by these glacial remnants.

During deglaciation, sediments were eroded from the ice-free valley walls and deposited at lower elevations in large proglacial lakes dammed by moraines and melting ice blocks. As these lakes drained, a series of deltas, alluvial fans, terraces and other relict watercourse features were left behind at various elevations, graded to the changing hydrological baselines. In the immediate vicinity of the present study area, conspicuous nearly level deltas occur at the mouths of major tributary streams such as Cooper and Hamill creeks. These are graded to an elevation of ca. 598 m / 1960 ft a.m.s.l., which correlates with the level of an extensive proglacial lake that can be traced southwestward to Richmond's (1968) "Great Terrace" on the Columbia River at the Grand Coulee where it was dammed by the Okanagan Ice Lobe. Radiocarbon dates on a much smaller lake in the Selkirk Trench to the west indicate that the prominent 598 m terrace system surrounding Kootenay and Duncan lakes was an emergent landsurface prior to 10,000 years ago (Choquette 1996). Below this elevation are additional terrace remnants, some of them apparently graded to higher post-glacial stands of Kootenay Lake prior to the outlet being carved by the ancestral Kootenay River to the level controlled by bedrock. One such lake level at 546 m / 1790 ft (ca. 45 feet above Kootenay Lake) was recognized by Fulton (1967: 59) during geological reconnaissance of the future Duncan Reservoir.

It is thus apparent that Duncan and Kootenay lakes were a single body of water as the outlet of the West Arm was being downcut. When the two became separate lakes is not known. A number of variables are at play which could well have produced several different lake levels. These include: erosion of the outlet; the aggradation of the fans of the Lardeau River (the lower portion of the fan is at the elevation identified by Fulton), Hamill Creek and Glacier Creek (which dammed Duncan Lake prior to creation of the Duncan Reservoir); and a significant change in hydrological regime undergone by the region's rivers, including the Kootenay River, around 2500 years ago. After that time, extensive previously inundated floodplains and deltas emerged as terraces above smaller floodplains developed within the previous channels. The significant reduction in fluvial discharge into Kootenay Lake during this time period may have resulted in its decline from the level denoted by a prominent beach ridge at the south edge of the community of Meadow Creek. The level of Kootenay Lake underwent further reduction during the post-contact period when Baillie-Grohman attempted to lower the bedrock ledge at the outlet and later when the lower Kootenay River became controlled by hydroelectric facilities. The latter altered the landscape in extending the seasonal duration of the emergent landsurface.

2.2 Palaeoecology

The only direct evidence for past vegetal regimes from the Duncan Lake locality relates to the interglacial between the last two Pleistocene glacial episodes. Parts of a fossil landscape with associated palaeosols and pollen assemblages dating between about 45,000 and 25,000 years ago were documented near Meadow Creek. During this interval, the climate apparently changed from being similar to the present to being somewhat cooler than the present (Alley et al 1986, Fulton and Warner 1990).

Other than a date of 10,270 $\pm$ 190 years before present on peat from the base of a bog 40 km south of Meadow Creek indicating that vegetation had become established by

that time (Fulton 1968: 1079), there is no information from the study area vicinity regarding the most recent postglacial period (the Holocene). It is thus necessary to extrapolate palaeoenvironments from surrounding regions. The Columbia River drainage was apparently deglaciated relatively early when compared to equivalent latitudes in North America (Choquette 1996). Sheltered from the retreating Continental and Fraser ice domes by mountains, the region would have been under the influence of predominantly dry northerly airflow in late Pleistocene times. Pollen studies have identified a pioneer community of grass, sage, cattails and scattered conifers as the first widespread vegetation in much of the upper Columbia River drainage 12,000 or more years ago. This cold desert "steppe tundra" habitat was forced to higher elevations after about 10,500 years ago, giving way to coniferous forests as a warming climate permitted their invasion of the valley bottoms and mountainsides. Charred plant remains on an early floodplain of the Kootenai River in Montana (Mierendorf 1984) indicate that fire was already part of the regional ecology by 11,730 + 410 years ago. Wildfire apparently increased in frequency until the trend to aridity and high solar insolation (the Altithermal / Hypsithermal) peaked around 8000 years ago when Douglas fir savannah grasslands were apparently widespread. Vegetal communities in the upper Columbia basin were relatively simple in composition between 10,000 and 7000 years ago and were characterized by pronounced altitudinal and latitudinal zonation (Choquette 1987a).

By 6000 years ago, a major climatic change was underway as the Maritime westerlies began to exert a dominating climatic influence. The predominant trend in vegetal configuration became longitudinal, and west-facing windward slopes became cloaked with dense forests. New plant communities developed in the storm tracks that now crossed the region and although the frequency of wildfires may have declined, their intensity may have increased (Hallett and Walker 2000). These factors contributed to the evolution of an increasingly varied and diverse vegetational mosaic during a series of increasingly colder cycles within the last 5000-6000 years. A global cooling trend, the Neoglacial, had begun to affect the region, resulting in the regrowth of cirque glaciers at higher elevations. The interval between ca. 6000 and 2500 years ago in the Kootenay drainage was characterized by high fluvial discharge and the region may have supported generally more extensive aquatic ecosystems, including larger resident fish and waterfowl populations as well as more productive riparian communities. The maritime elements of the regional flora such as cedar and hemlock made their first appearances 4000-5000 years ago and became common after 3000 b.p. Conditions between about 4000 and 2500 years ago were cooler than during subsequent millenia (Baker 1983) and were characterized by generally low forest fire frequency; forests expanded at the expense of grassland throughout the region. There is evidence for a second Neoglacial advance between ca. 3500 and 2500 years ago. This was followed by a relatively brief warm and dry interval during which forest fire frequency increased and parkland-grassland habitats expanded while fluvial discharge notably decreased, as noted in Section 2.1 above. The final glacial episode, the "Little Ice Age", reached its maximum expression between ca. AD 1630 and AD 1870 when it had become the most severe glacial episode in the upper Columbia drainage since the Pleistocene retreat more than 12,000 years ago. Inflow to Kootenay and Duncan lakes would have been markedly affected during this episode, especially in terms of discharge, sediment load and temperature. It is likely that much of the natural ecology of the study area represents the transition from Little Ice Age conditions to the modern industrially influenced climatic regime. The extensive riparian marshlands began to be cleared and cultivated by Euro-Americans around the turn of the last century as the water table declined.

At the present time, the paucity of palaeofaunal data from the study area limits our knowledge of the evolution of its wildlife populations The continental conditions of droughtiness and high fire frequency between ca. 9000 and 7000 years ago probably supported greater ungulate populations in the Purcell and Selkirk Mountains than were known historically, but this is hypothetical at present because of poor bone preservation and the lack of systematic archaeological investigation. When the westerly winds had begun to sweep regularly across the region after 6000 years ago, ungulate populations west of the Purcell Mountain crest would have declined as forest cover reduced their critical ranges. It is clear, however, that such populations would have not been static over the subsequent period. Fluctuations in deer, elk and caribou populations in response to climatic variation have been documented in the archaeological and ethnohistoric records further south (c.f. Choquette and Holstine 1982) that were probably reflected in the study area vicinity as well. For example, the abundance of deer and elk seem to covary inversely during warm and cold intervals, respectively. Caribou would have been favoured during the colder portions of the climatic cycles. An expansion of the range of whitetail deer north of 50^{o} North Latitude is apparent from reports of Schaeffer's Ktunaxa informants (Schaeffer 1940); this is probably related to European land use practices.

The environmental effects of the Little Ice Age were severe enough that they resulted in the disappearance of bison, antelope and prairie chicken from the East Kootenay and northwestern Montana. Given the evident extent of recent glaciation in the mountains surrounding the present study area, the animal residents would undoubtedly have been seriously affected by this severe climatic episode; its effect on human populations is undoubtedly one reason for the relative scarcity of aboriginal presence during the contact era.

The lakes and rivers in the study area supported large populations of a variety of fish species including rainbow, cutthroat and bull trout, ling cod and sturgeon. The presence of landlocked salmon in Kootenay Lake may be taken to indicate that anadromous salmon once ran at least that far but in historic times, Pacific salmon could not ascend the falls on the Kootenay River below Kootenay Lake. As mentioned previously, the 10,000 b.p. dates on the 488 m lake in the Selkirk Trench provide an upper limiting age for the present 532 m a.m.s.l. level of Kootenay Lake that is controlled by these falls. Allowing time for the Kootenay River to exhume the falls, it can be concluded that salmon could have been ascending into the study area during early postglacial time, as the mouth of the Columbia River and many of its major tributaries are well to the south of all of the Pleistocene ice fronts and salmon runs were undoubtedly established in that drainage long before most of British Columbia's other rivers could support them.

3. Archaeology

3.1 Previous Investigations

In 1966, prior to construction of Duncan Dam, a brief archaeological reconnaissance of the proposed reservoir pondage was carried out by David Keenlyside and Knut Fladmark. Five precontact archaeological sites were recorded, four on the east side of the lake and all associated with present-day beaches. Before this reconnaissance, one site (EbQf-1) had been recorded on the basis of information provided by a local resident who had found ground stone artifacts including pestles above the west shore of the lake

near Howser. In 2002 parts of the Duncan Reservoir were resurveyed and two additional sites and three isolated finds were documented (Choquette 2002).

Other quasi-systematic archaeological field investigations in the study area vicinity have consisted predominantly of localized archaeological impact assessments of proposed forest industry developments (e.g. Magee 1998, Campbell 2000, Lackowicz 2001, Kutenai West Heritage Consultants 1998, 1999, 2001, Handly 2002, 2003, Wood 2003, 2004, 2006, Burke 2005, Tamasi 2008).

The surrounding Provincial Forest lands have been mapped for archaeological potential during two recent Landscape Unit-based AOAs during which part of DL 881 was captured by archaeological potential polygons K26-32 and 33 (Choquette 2006).

3.2 Culture History

Because of the dearth of controlled archaeological data, especially from excavation, it is necessary to extrapolate a culture history sequence from adjacent areas. The most useful of this information is that which has been synthesized into a number of archaeological complexes that are constellations of attributes related to patterns of precontact human land and resource use (for more detail see Choquette 1984, 1987b, 1993 and 1996).

Evidence of human presence in the southern Purcell and Selkirk Mountains has been found on some of the earliest postglacial landforms, including those associated with stands of proglacial lakes, and in very early postglacial sedimentary contexts. The initial discovery of quarries for tool-making stone in the now heavily vegetated Purcell and Selkirk Mountains is best explained as having taken place at a time when vegetal cover was much sparser than during the later Holocene after Maritime coniferous forest had invaded the region. Finds of large spear points in the present-day forests above Kootenay Lake offer further support for suggesting that the valley sides of the Purcell Trench may have been hunting terrain for people prior to the establishment of heavy vegetal cover.

An archaeological trait constellation, the Goatfell Complex, has been defined to encompass the cultural deposits associated with these early landforms and sediments. Fine-grained microcrystalline stone such as tourmalinite, quartzite and siliceous metasiltite predominates in stratigraphically defined artifact assemblages. The sources of these materials are in quarried outcrops in the southern Purcell and central Selkirk mountains. The stone tool technology was primarily based on the production by percussion of large expanding flake blanks from large bifacial cores, edges of which were prepared by grinding. Large discoidal unifaces, large side scrapers, large stemmed weakly shouldered and lanceolate spear points plus a variety of large marginally retouched flakes are typical tools. Cultural ties are apparent with the early cultures of the Great Basin and the east slope of the Rocky Mountains at this early time level. The Goatfell Complex settlement pattern and economy are inferred to have consisted of winter inhabitation of lakeside camps and summertime hunting, gathering and quarrying in the surrounding mountains. At the present time, the pre-Mazama stratigraphic context and the early postglacial palaeohydrological setting indicate that the Goatfell Complex dates between about 11,000 and 8000 years ago but there are as yet no directly dated occupations. The largest spearpoints occur associated with upland landscapes above the elevations of the later proglacial lakes. There are also components associated with

landforms related to the earliest stages of the riverine regimes, for example, beside abandoned river channels and on fluvial bars and high erosional terraces. These components demonstrate a continued focus on the biface core and large expanding flake technology utilizing the same types of microcrystalline stone as described previously. However, cobble gravels were apparently more extensively utilized as tool stock than previously and the projectile points are slightly smaller stemmed and lanceolate forms. The reduction in projectile point size may represent the adoption of the spear thrower and different hunting methods. If these components are later (as their landform setting suggests), this change in hunting technology may reflect human adaptation to the changing early Holocene ecology, but at present there is too little data available to formally evaluate such an hypothesis.

The relatively abundant evidence of early postglacial human inhabitation of the Purcell Trench vicinity is a noteworthy feature of the archaeology of British Columbia. In contrast, there is very little controlled data from the West Kootenay area for the time period between about 7000 and 5000 years ago. This is reflected in a virtual hiatus at the Kettle Falls fishery during the Slawntehus Perod (Chance and Chance 1985). The present evidence from the study area consists of surface finds of large side-notched and side/corner-notched points similar to those dating to this time in adjacent regions. While the sparseness of data may reflect less intensive human use of the area (the data from Kettle Falls indicate a collapse of the early Holocene fishery), it could also be the result of the very limited systematic archaeological investigation in the region, especially in upland settings. It is apparent that the Rocky Mountains to the east supported significant human populations during this time.

As mentioned above, climatic conditions apparently became moister within the last 7000 years, especially after 5000 years ago as global cooling increased the influence of the Maritime Westerlies when the mean position of the storm track shifted southwards. In archaeological sites around Creston, in northern Idaho, and as far up the Kootenay River as the Libby, Montana vicinity, the distinctive siliceous metasiltite known as Kootenay Argillite is abundantly represented. The source of this stone is just south of the present study area, indicating that the north arm of Kootenay Lake was an especially important part of the aboriginal seasonal round between about 5000 and 2500 years ago when Kootenay Argillite attained its highest proportions in upriver artifact assemblages. In other parts of the region, this time period is characterized by a greater orientation to the resources of aquatic and riparian habitats by the resident human populations. It has also been hypothesized that salmon carrying capacity reached its maximum during this time period (Choquette 1985).

The Inissimi Complex was defined for the 5000 - 2500 BP time period to encompass a distinctive set of artifact assemblages on the Kootenay River and its major tributaries, from the big bend in northwestern Montana downstream at least as far as the north arm of Kootenay Lake. Sites containing Inissimi Complex assemblages occur on terraces and fans directly associated with specific hydrological features graded to later Holocene baselines, notably confluences, outlets, large eddies, beaches and rapids. Characteristic features of the Inissimi Complex are predominance of Kootenay Argillite and a distinctive form of projectile point with an expanding stem, a ground convex base, and acute to right-angled shoulders that is not found in surrounding regions. Other projectile points similar to those of contemporary components in adjacent areas (such as medium-sized contracting stemmed and leaf-shaped forms common to the west and south) occur in

lower frequencies. Other significant artifacts frequently found in Inissimi Complex deposits include bilaterally notched pebble sinkers.

The abundance and distribution of Kootenay Argillite in Inissimi Complex sites along Kootenay Lake and the Kootenay River as far upstream as Libby, Montana has been interpreted to reflect the use of canoes. The seasonal round is hypothesized to have consisted of wintering near the important deer winter ranges at the south end of the Purcell Mountains and a summer focus on the salmon fishery at the falls along the lower Kootenay River, which is hypothesized to have been at its maximum during the 5000-2500 BP time period. Prior to the return to the wintering area, a northward swing was made to obtain stone from quarries above the west side of the North Arm of Kootenay Lake and to hunt on the east side of the lake. Based on the abundance of Inissimi points in artifact collections from along the shores of Kootenay Lake and along the lower Kootenay River, it is apparent that Inissimi Complex sites are numerous. Considering the strong Maritime influence on the climate, the rain shadow effect may have enhanced the carrying capacity of the ungulate range on the east side of Kootenay Lake's north arm during this period.

With regard to the last 2500 years in the West Kootenay area, there is again little systematic archaeological data. In the Purcell Trench south of Kootenay Lake, some late Holocene archaeological sites are situated on the Kootenay River floodplain itself, in contrast to earlier sites which are instead restricted to the fringes of the great Kootenay River delta. This suggests a change in settlement pattern that is probably related to the end of the cool moist climatic conditions that prevailed between ca. 5000 and 2500 years ago. A different seasonal flow regime after about 2500 years ago apparently affected the level and size of Kootenay Lake along with the nature of flooding on the Kootenay River delta, with a concomitant shift in human adaptation and seasonal land use patterns. The Lower Ktunaxa lifeway known ethnographically represents the end product of these latest evolutionary changes; they continued to travel up Kootenay Lake by canoe well into the postcontact period including to fish for kokanee on the lower Duncan River (Greenlaw 2002: pers. comm.). The vicinity of the confluences of Meadow Creek and the Lardeau and Duncan rivers was an important and long-used fishing location for kokanee and bull trout (Alexander 1998).

The Lower Ktunaxa today comprise two bands who reside near Creston BC and Bonners Ferry, Idaho. Another group of Ktunaxa, the *Qatmuk'nek*, also frequented the Duncan Lake vicinity during their seasonal round which included both the winter ungulate range at the Columbia River's headwaters in the Rocky Mountain Trench and a summer salmon fishery on the Arrow Lakes. This transhumance included passage through the study area vicinity via the Jumbo and/or Earl Grey passes and travel up and down the Lardeau Valley corridor. The time depth of this settlement pattern is not yet known, but diagnostic artifacts of Kootenay Argillite dating typologically as old as ca. 5500 years have been found at the east end of this corridor in the Rocky Mountain Trench. Descendents of this group today reside near Windermere, BC. The major ethnographic works on the Ktunaxa are Schaeffer (1940, n.d.) and Turney-High (1941); Smith (1984) and Brunton (1998) have compiled recent syntheses.

Two other aboriginal groups were also at least seasonally present in the study area vicinity. The travel route through Earl Grey Pass was known locally as the Kinbasket Trail (Alexander 1998). The Kinbasket Band were speakers of the Secwepemc language, a division of the Salishan linguistic stock of the upper Thompson drainage.

The Kinbaskets were named for Kenpesket, a North Thompson chief (Teit 1909: 460, 467) who moved from the Adams Lake vicinity to near pre-dam Kinbasket Lake around 1840. They gradually moved southward where they eventually encountered the Ktunaxa whose numbers had been significantly reduced by disease. The two groups subsequently intermarried and some of their descendents are members of the present-day Shuswap Band of Invermere. It is likely that similar groups could have 'hived off' the main Fraser-Thompson population centres in the precontact past as well and made their way into the uppermost parts of the Columbia drainage as a result of the cyclic fluctuations in salmon carrying capacity. Teit's 1909 and 1930 accounts of the Secwepemc and Ignace's 1998 work comprise the bulk of written data for that group; the Kinbasket Band are currently assembling Traditional Use information.

A similarly episodic long-term local land use pattern likely characterized the other seasonally resident aboriginal group, the Sinixt, a northward extension of Okanagan-speakers distributed along the main stem and tributaries of the middle Columbia River. Some Sinixt today reside in the Slocan Valley while others are more closely affiliated with member bands of the Syilx (Okanagan Nation) which also includes the Colville Confederated Tribes in the United States. The major ethnographic work on the Sinixt is by Bouchard and Kennedy (1985, 2000). Historical records summarized by Bouchard and Kennedy indicate that the Sinixt were focused on Kettle Falls during the contact period and even overwintered there. The major villages were along the Columbia River not far north of Kettle Falls at the southern edge of their subsistence territory. Prior to the middle of the 19th century, however, the Sinixt were centred further north in the Columbia Valley north of Castlegar. The ethnohistoric records also indicate that their subsistence quest took them along a circuit by canoe up the north arm of Kootenay Lake with a westward return to the Arrow Lakes via the Lardeau Valley.

3.3 Euro-Canadian History

The post-contact history of the Duncan (formerly Howser) Lake vicinity began with prospecting and mining in the 1890's (Chapman 1981). Quite a few promising claims were staked and some were developed into mines that operated sporadically into the middle of the Twentieth Century. However, none produced sufficient ore to offset the difficulties of transport from this remote region, and an anticipated boom never took place. A second population influx occurred around the turn of the century as settlers, many of them English, were lured to the area with the promise of developing orchardry. While some stayed on and some agriculture was successful, transportation again proved to be an economic obstacle. When the First World War began, many men left the area and few returned.

During the early decades of development, both the Canadian Pacific and the Great Northern railways began construction of rail lines to the Duncan Valley, the former from Lardeau and the latter from Argenta. Because the local economy and population declined, neither railroad was ever completed. A railroad grade was built into the lower valley but rails were never laid. There was a minor and short-lived renewal of interest in mining during the early Twentieth Century, during which time the quarry at Marblehead saw several decades of production. Logging, at first in support of mining and railroad construction, subsequently became the economic mainstay and remains so today. Duncan Reservoir itself was created as part of the Columbia River Treaty Development when Duncan Dam was completed in 1968.

4. Study Methodology

This study was accomplished via a staged assessment process. The first stage consisted of assembling and reviewing relevant cultural heritage background information along with relevant geological, environmental and palaeoecological information, which has been summarized in the foregoing sections. This information was synthesized into a series of models derived from the existing heritage records through the evidence of precontact human land and resource use that comprises part of the archaeological record summarized in Section 3.1.2. Settlement pattern, lithic preference, subsistence base and palaeoenvironmental context as extrapolated from the landform, palaeohydrological and soil/sediment associations of the cultural deposits are especially significant in this regard. These models serve to predict the potential occurrence of archaeological remains by being combined with the results of a terrain analysis based on stereoscopic air photo analysis. A small proportion of the highest elevation portion of DL 881 was previously mapped for archaeological potential ancillary to the AOA of Landscape Unit K26 of the Kootenay Lake Forest District (Choquette 2006).

This analysis was supplemented by field reconnaissance which was oriented to obtaining more detail regarding the surficial geology and ecology, and confirming the potential for presence of archaeological deposits and/or features on the subject properties. The field survey was carried out via pedestrian traverses aimed at assessing topographic and ecological integrity and inspection of specific terrain features and subsurface exposures.

5. Results

The result of these efforts is the delineation of four zones of archaeological potential, which are described below.

5.1 Zone 1

This comprises the valley bottom floodplain complex where several large watercourses debouch into the large freshwater estuary at the head of Kootenay Lake. This is a depositional sedimentary environment. The very limited amount of pedogenesis associated with most subsurface exposures of the present landsurface and the lack of observed buried soils (eg. Figures) indicates that most of the subject properties have likely been inundated for almost all of the Holocene (recent postglacial) period by the waters of the ancestral and natural late precontact stands of Kootenay Lake, augmented by seasonal watercourse overflows.

An indication of the dynamism and recency of this landscape is provided by DL 1549, which in 1946 was part of Lot 219 and on the left bank of a secondary flood channel of the Duncan River. This lot is now a island created by a significant avulsion that turned the main channel, which at that time flowed against the west inner valley wall, into a cut-off oxbow. DL 1549 now is on the right bank of the new main channel which now runs essentially straight south from the confluence with the Lardeau River.

5.2 Zone 2

This zone is situated in the extreme northwest corner of DL 570. It encompasses a sequence of terraces extending upwards from the floodplain, where it is bounded on the southeast by Highway 31 (Figures). This landscape comprises the reworked composite delta-fan of Cooper Creek. As such, it includes a range of landforms, at the higher elevations consisting of a series of terraces graded to various proglacial lake levels and below which are terraces and probable beaches graded to later Holocene lake levels. These landforms are bounded by well-defined scarps and most of their surfaces are characterized by hummocky microtopography. Some of the surface irregularity is due to dissection of the higher delta surface after lake drainage and to bouldery terrace fill in places, but the majority can be attributed to the mature forest, especially cedar, the floor of which is criss-crossed by large downfall in various stages of decay. Besides the above, the surfaces of some of the terraces are notably depressional. Again, much of this is attributable to treefall, but other depressions are larger and/or do not appear to be of natural origin. They are not as large or obvious as typical housepits but may be storage pits. Of course, postcontact mineral prospecting must also be considered as a potential origin for at least some of these features.

5.3 Zone 3

In the southeast corner of DL 881, this zone consists of the eastern margin of the elevated bedrock structural bench on the west side of the Purcell Trench. Surficial materials are dominated by phyllite-rich till and sporadic bedrock ridges, amongst which are moist depressions; present forest is largely thick successional ICH but this locality probably also supported a more open vegetal cover at times in the past. Archaeological potential polygons K26-32 and 33 were mapped along southerly ridgecrests and depressional slopes (Choquette 2006); representative parts of both polygons are within DL 881 but these only capture a very small proportion of the local TRIM mapped surface water.

5.4 Zone 4

Much of western DL 881 and a very small part of the west edge of DL 570 are in this zone, which comprises steep bedrock cliffs and small sporadic structural benches which bound the alluvio-lacustrine plain on the west.

6. Assessment

6.1 Zone 1

This zone is largely a mesic floodplain complex that has been declining in elevation over millenia. It is likely that most of the surface topography of the subject properties is a very recent blanket of alluviolacustrine fine sediment. Such a depositional regime likely commenced as soon as any stagnant ice had melted away, the floodplain being subsequently and increasingly reworked by fluvial deposition and erosion, and by episodic wind and wave action. The high biological productivity of the present ecosystems would have drawn people here for as far back in time as life was present. For much of this time, activities would have been over open water where deposition of archaeological remains would most likely have been generally sparse and widespread.

There is definite potential for highly significant perishable remains in some deposits but predicting specific locations across essentially featureless terrain is highly imprecise, especially where primary deposition would have been influenced by water movement.

It is not outside the realm of possibility that the level of Kootenay Lake may have dropped as low as the postcontact natural stand during, for example, the minor late Neoglacial warm dry interval, or that the Duncan River floodplain may have aggraded significantly due to episodic Neoglacial additions to the alluvial fans of Cooper and Hamill creeks. However, the observed floodplain stratigraphy indicates that any palaeosurfaces that could have been temporarily occupied by humans prior to the Little Ice Age would be relatively deeply buried. Otherwise, concentrated archaeological remains would tend to be situated on terrain predictably available for human inhabitation during times of low water; this would consist of localized sediment accumulations that are now represented by small elevated areas in the subject properties. The types of human activity most likely to have left *in situ* primary material evidence would be that focussed repeatedly on specific locations, such as embarkation/disembarkation, food processing or encampment, in settings which are characterized by relatively better drainage than the surrounding areas. These include natural levees (Figure) and point bars along the Duncan River, sandy beach ridges (Figure) and the middle portions of the Neoglacial fans of Hamill and Cooper creeks (Figure). As these features are graded to Neoglacial hydrology, some are candidates as foci for the Inissimi Complex settlement pattern while others could have been utilized by the late precontact Ktunaxa and Sinixt, both of whom were also canoe-based. There is potential for isolated finds of archaeological material throughout this entire zone.

6.2 Zone 2

This zone encompasses a chronosequence of relatively level terraces bounded by scarps that are part of the Cooper Creek fan. They have high heritage value, not only due to their potential for associated archaeological deposits and/or features but also because in themselves they comprise a record of the lowering local hydrological baseline.

There appears to be minor artificial disturbance in this zone that is of obvious post-contact origin, i.e. this is apparently a remnant low elevation natural habitat, largely pristine except for the significant effect of fire suppression. While no definite precontact archaeological remains were identified, there is very little subsurface exposure, which consisted of a few large tree throws and wildlife trails. The terraces appear mostly boulder-cored but have fine sediment caps which could contain cultural deposits of a wide range of ages extending back to early postglacial time relating to activities ranging from travel through hunting and gathering to seasonal habitation. This landform sequence includes those typically occupied by people of both the Goatfell and Inissimi complexes.

6.3 Zone 3

Archaeological potential polygons K26-32 and 33 capture parts of south-facing ridgecrests and depressional slopes in the southeast corner of DL 881. These are areas where archaeological evidence might be expected to accumulate due to activity related to two hypothetical precontact human land/resource patterns: pedestrian travel along the set of structural benches on this side of the valley above the ancient lake or later

floodplain, or related to temporary subsistence pursuits such as hunting and gathering. As noted previously, the ungulate capability and potential for edible plant resources such as berries would have been higher during early fire succession episodes which likely would have extended back into early postglacial time; the finds of some early Goatfell Complex spearpoints on this now elevated terrain above Kootenay Lake's North Arm to the south is significant in this regard.

6.4 Zone 4

By their very nature, the steep bedrock cliffs in western DL 881 and DL 570 have generally low archaeological potential because of the steep slopes and difficult access. Precontact human use of this landscape is unlikely to have been sufficiently intense as to have left much if any intact archaeologically detectable evidence. No rock art or rockshelters of any suitable size were observed but very little of this terrain was physically traversed during this study. Therefore, some potential does exist for rock art and rockshelters to be present that can only be addressed by more intensive investigation.

7. Management Considerations and Recommendations

7.1 Zone 1

Most of the surface of this zone, which encompasses the large majority of the area of the subject properties, is capped by water, relatively dense vegetation or recent alluvium; much of it has been cleared and cultivated. Such terrain is amenable for a wide variety of activities that do not affect the subsurface below about 50 cm, and deeper than this depending upon the depositional specifics of the location. Any disturbances below this depth may pose a threat to pre-1846 archaeological remains, but considerably more information regarding the stratigraphy of this plain is needed before such a threat can be assessed in any detail.

While it can be predicted that certain topographic highs would have been attractive or suitable for repeated human activities, there is variability in stratigraphy in the observed range of elevated landforms. Again, better information is required regarding this important characteristic, but for the present it can be stated that elevated landforms on the alluviolacustrine bottomlands on all of the properties have high potential for significant archaeological remains, including their undisturbed surfaces. It must be noted that because of their elevated position, these landforms have tended already to be targeted for roads, borrow pits and other types of post-contact disturbances. The archaeological value of these developments is often degraded and they are thus potentially suitable as locations for some types of future activity.

It is recommended that any proposed excavations or other *disturbances of the mineral soil of the level floodplain exceeding 50 cm in depth should be accompanied by archaeological monitoring* and the stratigraphy recorded by an individual competent to do so.

It is recommended that any proposed excavations or other *disturbances of the mineral soil on elevated areas such as the banks of present or relict watercourses*

plus ridges, knolls and fans should be reviewed by a qualified archaeologist **when the locations have been determined in sufficient detail.**

7.2 Zone 2

The terraces here appear to be mostly boulder-cored but with fine sediment caps which should not be disrupted, either physically or thermally. These considerations are especially relevant with regard to future removal and disposal of ingrowth in much of this zone.

Vehicle and machine movements should be restricted to the existing access, except for random surface light machine movement which is permissible across terrace interiors. However, level areas within 30 m of terrace margins should be machine-free and no additional bladed structures should be built without more intensive prior archaeological investigation.

Slash should not be burnt directly atop any intact level areas; use of a sloop set on an existing disturbed area is recommended if material is to be burnt onsite.

7.3 Zone 3

The areas captured by archaeological potential polygons K26-32 and 33 define the landscape of this zone where archaeological deposits or features are expected to occur. Any remains are likely to be sparse and localized, but also very close to the surface. As such, precontact cultural deposits are vulnerable to any disturbances of mineral soil.

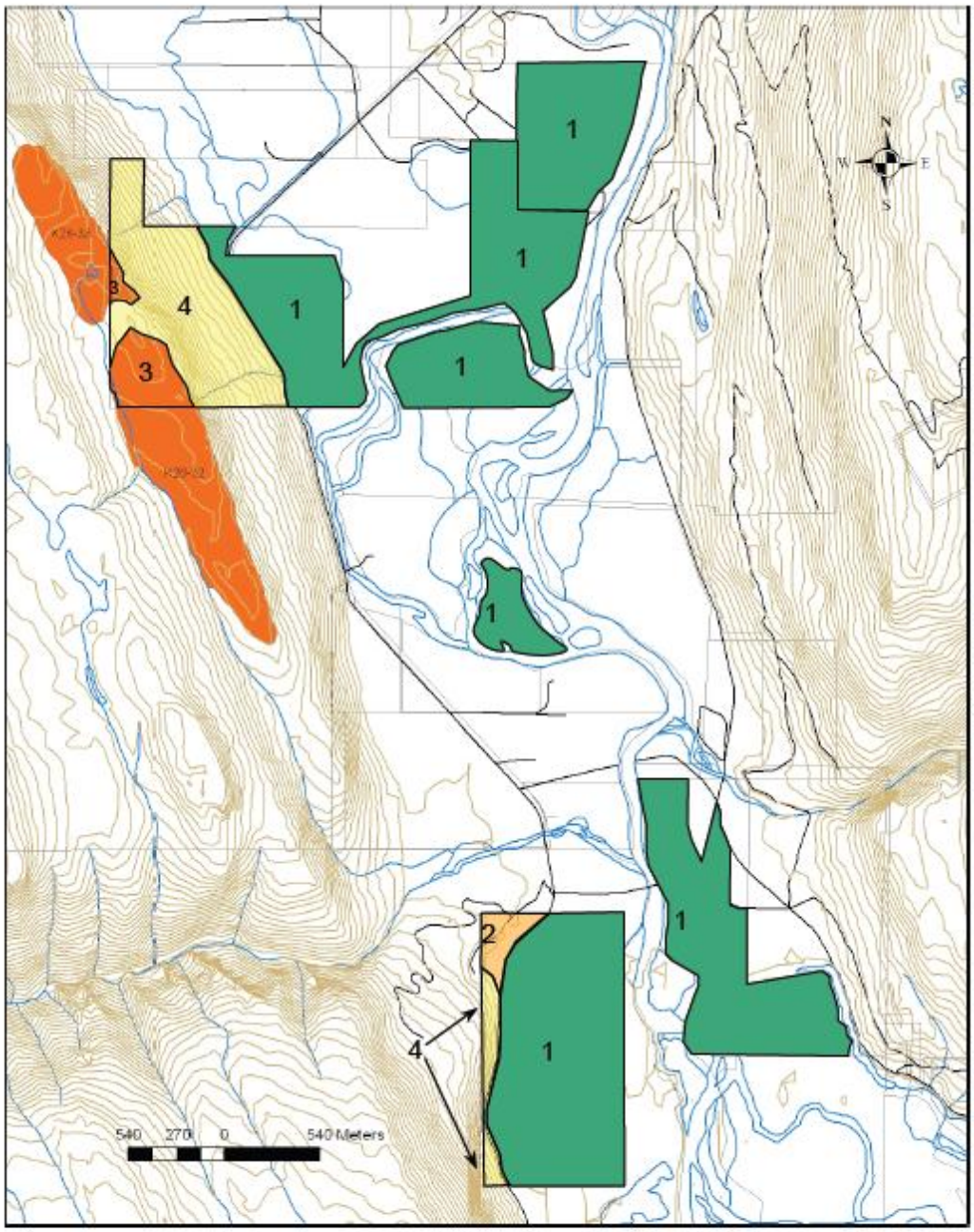
As with Zone 2, **use of existing access and disturbed areas such as landings is recommended, including for use of burning sloops. Any proposed actions that might cause disruption of intact mineral soil such as additional bladed structures, trenching or scarification should be preceded by more intensive archaeological investigation.**

7.4 Zone 4

Rock art and rockshelters can be highly culturally significant, including their surroundings such as viewscapes. Due to the small possibility that such sites might be present in this zone, **the locations of any proposed disturbances to rock faces or mineral soil should be reviewed by a qualified archaeologist.**

7.5 Culturally Modified Trees

It must be emphasized that this study focuses on precontact archaeological resources; its methodology is only partly suitable to predict locations of culturally modified trees, which are also protected heritage resources. In general, much of the terrain in the study area is not suitable for their presence due either to the recency of the landscape or to wildfire history. However, sufficiently old landforms are present in most of the subject properties that for various historic reasons have not been logged or burned, so there is a possibility for their existence which would be more reliably determined by field reconnaissance of areas containing old growth forest. Therefore, ***it is recommended that the presence of culturally modified trees be determined by field survey.***



Map 1. Lower Duncan Conservation Property Complex,
Archaeolaogical Stewardship Zones.

Appendix 6: Lower Duncan Strategic Management Plan: Fire Management Planning

LOWER DUNCAN STRATEGIC MANAGEMENT PLAN: FIRE MANAGEMENT PLANNING

Prepared by:
Robert Mitchell, R.P.F.

AREA DESCRIPTION:

Fire management planning analysis and prescriptions encompass the 10 rural properties collectively referred to as the Lower Duncan conservation properties (LDCP). These lands are owned by the Nature Trust, Ministry of Environment and vacant crown land parcels managed specifically for environmental and wildlife habitat values.
The LDCP lands are situated at the north end of Kootenay Lake and extend, discontinuously, to the north as far as the Meadow Creek Spawning Channel lands.
The properties are intermingled with private lands that are used for a variety of uses including residential, industrial, agricultural and forestland purposes.
The total area encompassed by the LDCP is 616.4 ha

OBJECTIVE:

The objectives of this report are to:

A. Identify the organizations responsible for the development of a Fire Prevention and Control Plan for the LDCP and provide the rationale for such a plan;
B. Indentify the priority areas requiring immediate attention with respect to reducing fuel loading; and
C. Identify sites requiring a physically constructed fire break designed to contain or control a wildfire event.

METHODOLOGY:

The LDCP were reviewed by means of Google Earth ™ imagery, lot lines were projected onto the images and an overview of the properties, strata of interest and adjacent properties was completed prior to a field visit.
All of the properties were visited and all strata assessed.
Assessments of the properties entailed a walkthrough to visit identified strata.
Each of the strata was evaluated by means of a FireSmart Area Hazard Assessment Form. This form evaluates the five most significant risk factors that

contribute to an areas overall fire hazard, or vulnerability to wildfire impacts. The FireSmart methodologies were only marginally applicable to the area wide assessments being carried out on the LDCP but did provide a framework for the assessments. A summary of the relevant FireSmart Area Hazard Assessment aspects is shown in Appendix I.

Residential and agricultural adjacency, along with forest cover attributes were considered to arrive at an overall rating of Area Hazard Rating. Detailed analyses can be found in Attachment .

Local knowledge of fire incidence, vulnerabilities and risks was solicited via personal interviews and Open House discussions with knowledgeable community members. Local fire wardens and volunteer fire fighting organizations were interviewed.

For discussion and recommendation purposes, contiguous properties or properties with similar forest or geo-physical attributes were clumped together wherever possible to minimize replication of comments or recommendations. Kootenay Lake Forest District firefighting personnel were interviewed regarding fire planning and fire fighting responsibilities for the LDCP.

Local knowledge and personal experience in this management area were drawn upon to accurately assess the properties, formulate strategies and address the objectives of this report.

DISCUSSION:

Ecology and Fire Influence.

The vast majority of the properties occupy riparian bottomlands in the Interior Cedar-Hemlock (ICH) Biogeoclimatic Zone. The western extreme of District Lot 881 extends from the bottom lands, elevation 550m, up the western side hill to an elevation of 980m.

All of the properties lie in the Moist-Warm variant of the Interior Cedar Hemlock Moist & Warm climatic subzone (ICHmw2). This subzone is characterized by hot, moist summers and mild winters with little snowfall. Low lying areas, like those in the majority of the LDCP, are subject to frost and this is sometimes growth limiting in depressional areas.

Soils within the bottomland properties are typically fluvial in origin, finely textured and capable of holding water for much of the growing season. Seepage occurs at a soil depth of 25-100cm. These sites rarely dry and decomposition continues throughout the growing season. Nutrient cycling is fast and detritus accumulations limited.

Fire ecology within the ICHmw2 and the conservation lands is naturally controlled by moist climatic influences. Fire is a recurrent influence on the landscape, resulting in a mosaic of climax and seral forest stands. Low land areas of the ICHmw2, as found in the LDCP, are infrequently affected by forest fire and historically support an old-growth dependent wildlife community. Only a portion of one property, DL 881, occupies a coarse soiled, shallow-to-bedrock site that

has a much higher likelihood of fire and a relatively quick fire-return period when compared to the valley bottom properties.

Fire Prevention Planning & Fire Fighting on LDC Properties.

Fire prevention planning.

The Regional District of Central Kootenay has recently commissioned (2007/8) Community Wildfire Protection Plans for the largest communities within the RDCK. As an addendum to that process, the RDCK commissioned additional reports on Wildland Urban Interface Management in 13 smaller communities and hamlets in the RD.
(*http:www.rdck.bc.ca/publicinfo/community_wildfire_protection_plans/kaslo_fire_protection_area.html*)
Reports were completed for the adjacent communities of Argenta and Cooper Creek.
The Argenta and Cooper Creek reports evaluate the probability of forest fire, fuel types and treatment areas to minimize residential damage. All planning and control efforts are directed toward protection of people and capital assets.

The Provincial Ministry of Forests and Range (MOFR) undertakes a readiness analysis and risk-management process to determine the allocation of forest fire fighting resources throughout the province and within regions.
The MOFR maintains a cache of fire fighting tools in the community of Lardeau.
Monitoring of forest fire hazards throughout the province is completed via a system of weather stations and electronic data transmission.
No specific planning or other commitments have been undertaken in regard to the LDCP.

Local forest management licensees are responsible for preparing a Fire Control Plan under the Provincial Wildfire Regulation (PWR). Two local forest licensees operate in the vicinity of the LDCP; Meadow Creek Cedar Ltd. and the Kaslo and District Community Forest License. Under the PWR these licensee are responsible for maintaining a cache of fire fighting tools and taking fire control action on lands under their jurisdiction. As the LDCP are not managed by a forest licensee there is no responsibility for the local licensees to plan for, or take action on, fires within the LDCP.

Fire fighting on LDC properties.

All MOFR fire efforts are directed at controlling fire on the provincial forest land base, potentially affected communities and structural assets. They have fought fire on the LDCP and express a continued willingness to do so.

Local volunteer fire fighting groups exist in Howser, Meadow Creek, Cooper Creek and Argenta. The levels of volunteer commitment and resources vary

between the communities. All of these communities have small, portable water delivery systems. Several have fire tool caches in various states of readiness. All are designed to take action on structural fires in their communities. Local mills and loggers provide machine support on an ad hoc, as available basis.
Some of the volunteer groups have taken action on forest fires where the personal risks are low and the forest fire poses some threat to the communities or other assets of value to the community. These groups take initial attack action and hold forest fires until the MOFR fire personnel take over.
The local volunteer groups have fought fire on the LDCP in the past and express a continued willingness to do so.

Local forest licensees are ever cognizant of the expense of fire fighting and will not incur expenses to fight fire on the LDCP. Their involvement on the LDCP will be restricted to abating fires that pose a direct risk to their properties, real assets or tenure areas.

Priority Areas Requiring Immediate Attention To Reduce Fuel Loading.

Properties DL 7450 & 12852 (Majority grassland with minority forest cover.):

The unmanaged grasslands in these properties accumulate detritus over the years which builds to significant depths. These fuel loads are extremely risky fuel types in the early spring when snows recede and these fuels dry out before new-growth onset. Local firefighters have witnessed these fields burning with flame heights of 50 feet. This pasture-dominated property poses a relatively high risk to adjacent private properties and forest lands.

Potential control actions:
Burn the accumulated detritus on an annual basis. Adjacent residents would probably assist in this endeavor as it minimizes the fire risk to their own properties.
Manage the lands for agricultural/forage use and harvest the forage crop on a regular basis.
Reforest these lands and thereby minimize grass production and related risks.
Reduce ground and ladder fuels along wooded perimeter of forest lands within this property. Treat first 50m of interface to retard spread of grass fire into the forested lands.

Property DL 570 (Majority forested with minor pasture in south east.):

The presence of residential properties on the northern edge of this property presents a minor risk of fire initiation and spread into the LDCP.

The presence of a managed pasture land in the southern most reaches of this property presents a minor risk of fire initiation and spread into the balance of the property at times of peak risk in early spring. Fire risk in this pasture is relatively low due to the small size of the pasture, lack of residential adjacency and the irregularity of the border which disrupts continuity and spread risk.

Potential control actions:
Reduce the ground, ladder and crown fuels along the northern boundary adjacent to residences. Treat first 50m of interface to retard spread of fire from residential property into the LDCP. Removal of crown fuels will require harvesting of some conifers. Retain all deciduous in overstory. Reduce ground and ladder fuels adjacent to the southern pasture for a distance of 50m around the pasture perimeter.

Sites Requiring a Physically Constructed Fire Break or Access Modification.

Fire breaks are manmade or natural breaks in the fuels designed to disrupt the spread of fire. Strategically placed fire breaks can minimize the impacts of wildfire on forest lands and other features of value to property managers.
The LDCP are all situated within the riparian networks of Meadow and John Creeks and the flood plains of the Duncan and Lardeau River systems.
The LDCP are highly interwoven by natural and man-made watercourses. Three of the properties are completely surrounded by large, flowing river channels.
The LDCP are all contained within a network of highways and forest roads.
Several of the properties have roads and trail networks within their confines.
Viewed as a whole, the LDCP have an abundance of fuel breaks that will militate against the spread of wildfire within the properties. Few opportunities exist for establishment of new, meaningful firebreaks within the LDCP.
Widening of existing roads and trails within some of the properties would bolster the existing fire breaks and slow the spread of windblown crown fires in the unlikely event that a crown fire should roll through these deciduous dominated properties.

Access modification is advisable in the western portions of DL 881 (Mixed clearcut, forest and pasture lands). This property, while at only minor risk from adjacent agricultural burning practices, has a relatively high risk of fire spread due to the presence of unabated slash within the clearcut and selection-harvest areas on the steep sidehill of this property. The lower road into the western most sidehill portion of this property, immediately accessible from highway, should be deactivated to reduce human access. The upper road access from Br 1 of Meadow Mtn. road should be maintained for fire control access.
The continuous ingress of deciduous brush and coniferous regeneration in the harvested portions of this block is effectively shading the slash and retards drying of the slash and fire spread.

RECOMMENDATIONS:

It is clear that the LDCP are managed as de facto crown woodlands in an area where no organization has an applicable Fire Prevention and Control Plan.
The need for a Fire Prevention Plan on the LDCP is not immediately apparent. These lands are unoccupied forest lands with no industrial or residential use. An argument might be made that a fire originating on the LDCP that spreads onto adjacent private lands may pose some liability for the LDCP landowner. The validity of this legal argument needs to be considered by the owners and legal counsel with particular reference to the PWR.
Fire management and control efforts on the relatively small and isolated LDCP will be expensive to organize and implement. It is clear that the only cost effective fire control program will be a partnership with the existing local volunteer fire fighters, local forest licensees and/or the MOFR fire control services. A cost sharing arrangement with either of these organizations would ensure an elevated commitment from those parties to action fires on the LDCP. The details of such an arrangement would have to be negotiated on a fee-for-service or quid-pro-quo basis.

If the owners and managers of these lands conclude that a Fire Prevention and Control Plan is desirable it is incumbent on them to prepare one. Planning partnerships may be explored with the local forest licensees, local volunteer fire fighting groups or MOFR fire control departments.

Properties DL 12852 &7450 and DL 570 should be treated to reduce the grassland fire risks within those properties. The greatest hazards from the grasslands exists during the early spring season when Fine Fuel Moisture Content of the grasses and adjacent understory is Low and the areas have not yet begun seasonal greenup.
DL 12852 & 7450 grasslands present a considerable risk to the timbered portion of the property and adjoining private properties.
Fuels around the timbered margins of these grasslands should be modified to reduce the spread of fire from the grasslands into the timbered areas.

Portions of property DL 881 have extensive areas of unabated harvesting slash that presents a heightened risk of fire spread throughout this property. The lower access road into this property should be semi-permanently deactivated to discourage vehicular traffic and human access to the property.

R. Mitchell, RPF #2150
June 1st, 2009

Attachment 1: Lower Duncan Conservation Properties - Property Attribute Tables

Lot	**DL 257 West (conifer dominated)**
Area	**15 ha (est'd)**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	25
Surface Vegetation 0-30	20
Ladder Fuels 0-10	0
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	45
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	EXT
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Conifer
Vertical Structure: Dom, Dom. w. co-doms	Dominant
Crown Closure: Continuous, Discontinuous, Open	Continuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 257 East (Cottonwood dominated)**
Area	**24 ha (est'd)**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	0
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	10
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Deciduous
Vertical Structure: Dom, Dom. w. co-doms	Dominant
Crown Closure: Continuous, Discontinuous, Open	Discontinuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 570**
Area	**108 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	10
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	20
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	Y
Agricultural Interface: Y/N	Y
Cover type(%): Con, Decid, Pasture, Mix	Mixed in north, Deciduous in south
Vertical Structure: Dom, Dom. w. co-doms	Dom. w. conif. co-doms(N), Dom(S)
Crown Closure: Continuous, Discontinuous, Open	Continuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 879 & DL 880**
Area	**35 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	15(High Cedar content)
Surface Vegetation 0-30	10(“)
Ladder Fuels 0-10	5(“)
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	30
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	HIGH
Residential Interface: Y/N	Y(very limited)
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Deciduous-dominated mixed wood.
Vertical Structure: Dom, Dom. w. co-doms	Dominant w. co-dominants
Crown Closure: Continuous, Discontinuous, Open	Continuous in east, Discontinuous in west by rearing channels.
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 881 East of Highway**
Area	**112 ha (est'd)**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	15
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	25
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	MODERATE
Residential Interface: Y/N	N
Agricultural Interface: Y/N	Y
Cover type(%): Con, Decid, Pasture, Mix	Deciduous w. cedar/spruce ingress & Pasture
Vertical Structure: Dom, Dom. w. co-doms	Decid. Dom w. minor conifer co-dom & Pasture
Crown Closure: Continuous, Discontinuous, Open	Discontinuous-Open
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**LOW**

Lot	**DL 881 West of Highway**
Area	**100 ha (est'd)**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	10
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	8
Position on Slope 0-5	3
Total Score all Factors	31
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	HIGH
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Con-Decid mixed
Vertical Structure: Dom, Dom. w. co-doms	Dom. conifers in select harvest, regen/shrubs in balance.
Crown Closure: Continuous, Discontinuous, Open	Discontinuous-Open
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 896**
Area	**44 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	10
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	20
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Deciduous
Vertical Structure: Dom, Dom. w. co-doms	Dom
Crown Closure: Continuous, Discontinuous, Open	Continuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**LOW**

Lot	**DL 1549**
Area	**18 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	5
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	15
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Decid. w. minor conif. Ingress
Vertical Structure: Dom, Dom. w. co-doms	Dominant
Crown Closure: Continuous, Discontinuous, Open	Continuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**LOW**

Lot	**DL 1884**
Area	**3.4 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	30
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	4
Position on Slope 0-5	0
Total Score all Factors	44
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	EXTREME
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Mixed
Vertical Structure: Dom, Dom. w. co-doms	Dominant w. co-doms
Crown Closure: Continuous, Discontinuous, Open	Discontinuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 7450**
Area	**26 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	0
Surface Vegetation 0-30	5
Ladder Fuels 0-10	0
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	5
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	Y
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Pasture
Vertical Structure: Dom, Dom. w. co-doms	None
Crown Closure: Continuous, Discontinuous, Open	Open
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**MODERATE**

Lot	**DL 8895**
Area	**40 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	5
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	15
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Deciduous w. minor conifer ingress
Vertical Structure: Dom, Dom. w. co-doms	Decid. Dom w. minor conifer co-dom
Crown Closure: Continuous, Discontinuous, Open	Discontinuous-Open
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**LOW**

Lot	**DL 12852**
Area	**54 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	0
Surface Vegetation 0-30	5
Ladder Fuels 0-10	0
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	5
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	Y
Agricultural Interface: Y/N	Y
Cover type(%): Con, Decid, Pasture, Mix	Pasture 70% Conifer-Decid 30%
Vertical Structure: Dom, Dom. w. co-doms	Timber has Dom. Structure type.
Crown Closure: Continuous, Discontinuous, Open	Continuous.
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**HIGH**

Lot	**DL 16024**
Area	**37 ha**
FireSmart Area Hazard Scoring:	
Forest Vegetation 0-30	0
Surface Vegetation 0-30	5
Ladder Fuels 0-10	5
Slope 0-10	0
Position on Slope 0-5	0
Total Score all Factors	10
Area Hazard Level (FS) * *Low <21pt Moderate 21-29pt High 30-35pt Ext>35 pt	LOW
Residential Interface: Y/N	N
Agricultural Interface: Y/N	N
Cover type(%): Con, Decid, Pasture, Mix	Deciduous
Vertical Structure: Dom, Dom. w. co-doms	Dominant
Crown Closure: Continuous, Discontinuous, Open	Discontinuous
Area Hazard Rating with interface risks, Cover types, Crown structure and riparian influence reflected:	**LOW**

Attachment 2: Area Hazard Assessment Form

AREA HAZARD ASSESSMENT FORM

Factor	Page reference	Characteristics and point ratings				Score
12 Forest vegetation (overstory)	2-18	Deciduous	Mixed wood	Coniferous		
				Separated	Continuous	
		0	15	15	30	
13 Surface vegetation	2-18	Lawn or non-combustible material	Wild grass or shrubs	Dead and down woody material		
				Scattered	Abundant	
		0	5	30	30	
14 Ladder fuels	2-18	Absent	Scattered	Continuous		
		0	5	10		
15 Slope	2-19	0 - 10%	10 - 25%	>25%		
			Even / Gullied	Even	Gullied	
		0	4 / 5	8	10	
16 Position on slope	2-20	Valley bottom or lower slope	Mid-slope	Upper-slope		
		0	3	5		
					Total Score for Factors 12 – 16	
					Area Hazard Level	

Hazard Level Low <21 points Moderate 21-29 points High 30-35 points Extreme >35 points

Remarks

Appendix 7: Duncan-Lardeau Public Advisory Committee 1979-1999

Duncan-Lardeau Public Advisory Committee 1979-1999

Prepared by:
Brenda Herbison, RPBio.

Brief chronology

- **1976.** Local efforts to secure the lower Duncan-Lardeau flats for wildlife began with a proposal, a petition, many letters, news articles, etc. that had strong support within the Lardeau valley as well as the active support of conservation groups throughout the West and East Kootenay.
- **1978** First purchase (Lot 570) by the Nature Trust of B.C. (TNT)[1]. This was followed by a 99-year management lease with Ministry of Environment (MOE), and incorporating Crown properties 16024 and part of 896 in a geographically-defined wildlife management area.
- **1979, April.** A public meeting held in Meadow Creek was called by TNT, Ministry of Environment (MOE) to announce the formal establishment of the Duncan-Lardeau flats, to outline potential future management options, and to select a public advisory committee (hereafter DLPAC) to provide advice on management options, policies, and decisions.
- **1979 to 1996**. After the first meeting of the DLPAC (May 1979) there were approximately 15 meetings / field trips held over the following ~ 18 years (Minutes available). The DLPAC debated and voted on a number of policy and management issues in discussion with MOE; it reviewed and contributed to 3 different MOE management plans as well as to numerous miscellaneous short-term plans; it carried out some direct "hands-on "actions (at least some members), and it continued efforts to acquire more additional land for habitat (with both successes and failures).
- **1996? – 1998?** The DL PAC did not meet during this period for a few years due, in part, to apparent lack of need / reason to meet. During this same period the management of the properties was shifted (unofficially) from MOE to the Columbia Basin Fish and Wildlife Compensation Program (FWCP).
- **1998 A** meeting of concerned residents was held with FWCP in Meadow Creek in response to local concerns about purchase of Lot 881. At this meeting a "new" advisory committee was established (unwittingly on the part of FWCP who at the time were relatively new on the scene and were not aware of the existing DLPAC structure). After some confusion the new PAC met soon melded with the old PAC by mutual local agreement.
- **1999** The "melded" DLPAC met twice, both times to discuss and respond to the 1998 draft management plan of Poole et al. *There were no meetings of any advisory body between 1999/2000 and 2009. It appears that most ex-members and the FWCP assume the group has dissolved.*

Details on membership, terms of reference, and DLPAC positions on issues are provided in sections below.

[1] At that time called the "National Second Century Fund of B.C."

Membership – Representation - Process

Members were selected at the April 1979 public meeting through a MOE/TNT request for nominees (from the floor), followed by a general vote (from the floor). The request for nominees was focused on two 'stakeholder' categories:

- Established conservation/environmental groups (with a name), and
- Adjacent land owners

The desired group size was stated by MOE as eight (8), with up to 12 with if government reps attended.

The 8 members of the DLPAC selected at the April 1979 meeting were:

- Mike Halleran (chairman)
- Roy Lake (adjacent landowner)
- Margaret Barwis (West Kootenay Naturalists, Nelson)
- Lawson LeGate (West Kootenay Sierra Club, Nelson)
- Bill Blanchard (West Kootenay Outdoorsman, Balfour)
- Brenda Herbison (Argenta Resource Folio Committee; adjacent landowner)
- Hugh Elliot (previous owner of Lot 570 sold to TNT)
- Ernie Alexander, adjacent landowner

- It was the responsibility of each member to fairly represent their group or constituency and to relay information back to their constituency from the DLPAC.

- Meetings were usually once per year; could be called more often as needed, by either the Chair or MOE, or by any member through MOE / chair. Meetings were usually fieldtrips on the property followed by an indoor session and took most of the day. A MOE rep was a part of nearly all meetings.

- The committee operated using "Roberts Rules of Order" through most of its history (It had a chairperson, passed motions by voting, etc.). The structure relaxed somewhat near the end. Minutes were always recorded and circulated to all for comments/corrections.

- During the functional years of the DLPAC, recruitment of new DLPAC members, to replace outgoing or retiring ones, occurred through by the resigning person appointing new person (someone to "fill their shoes"). In this way, elections were avoided, the group size remained more or less the same, and the basic balance of the group remained the same over the years. The participation by Nelson members gradually decreased as the years went by.

(Jur Bekker replaced Hugh Elliot through t the 1980s, Terry Halleran filled in for Mike Halleran in late 1990s, and so on. Nigel Starbuck was added to the PAC after KLSS property was purchased by TNT in 1982, but since by then the Sierra Club rep was no longer attending the groups size did not change. Tom Fussy (BCWF / NAWC) came to permanently replace Bill Blanchard. Brenda Herbison replaced Mike Halleran as chairperson from 1984 to 1996)

During the hybrid "melded" DLPAC of 1998-1999 (two meetings) the members consisted of Don Edwards, Don Hallam, Tom Fussy, Rowena Eloise, Jim Lawrence, Kelly Abbey, Brenda Herbison.

Terms of Reference

The purpose of the Advisory Committee (DLPAC), according to the Ministry of Environment (MOE) (1979), was to provide advice on management issues within (or affecting) the Duncan-Lardeau flats wildlife properties. The DLPAC provided advice at a policy level as well as at an operational or "hands-on" level. The DLPAC was clearly not considered by MOE to be a decision-making body.

There were no formally written Terms of Reference at the outset. A written set were drafted by the DLPAC and reviewed by MOE in 1985 but were never finalized.

Record of DLPAC positions on management policies and practices

The DL PAC formally debated a number of issues and passed motions on a number of policies and practices over the years. The decisions made within the committee and some of the reasons are summarized below.

- **Hunting**

Hotly but briefly debated in the beginning. Somewhat split opinion. The majority in the DLPAC voted in favour of keeping most of WMA open to hunting for the time being, at least, in recognition of the key role served by hunting groups in protecting/securing the area. There was consensus over adopting a hunting closure along the Argenta slough, east side of the flats. (This was eventually adopted in provincial regulations.)

- **Cattle Grazing**

1979-1989 Cattle-grazing was a frequently-debated issue, arising at almost every DLPAC meeting. Initially, the DLPAC agreed to allow historic grazing to continue as a wildlife habitat management tool, (for apparent benefit of Canada geese, most notably), on the understanding that its effectiveness would be frequently reassessed. (but) no horses, sheep or donkeys' .. (1979)).

1989 The DLPAC voted to discontinue cattle grazing. This was compatible with the MOE position by that time. In the end, the reasons for discontinuing grazing were:

- impact on browse preferred by elk and deer (notably red osier dogwood)
- cattle benefitting from ungulate enhancement slashing more than deer/elk
- recent research in USA indicating elk avoid cattle
- problems with enforcement

- **Controlled Burning**

At initial meetings, the DLPAC agreed in principal to the use of prescribed fire to apply to the open meadow areas and occasionally to shrub communities. The issue continued to spark controversy in future meetings, however, in part due to subtle membership changes, and in part because the local public was sensitized by several unfortunate fire occurrences[2]. Objecting members were usually in the minority, so most proposed burns went ahead. *See Site Histories, Appendix, for more on fire history.*

[2] There was a spectacular burn that ignited a large amount of driftwood on the west side of the flats in 1982(3?) It continued for days and caused a great deterioration in public acceptance. After that there were several illegally ignited burns that got out of control and eroded both public and MOE/ FWCP confidence in the feasibility of fire as a management tool in this location.

- **Slashing to create deer and elk browse**

Most, (not all) DLPAC members supported the idea of occasional slashing to maintain browse quality for deer and elk. Opposition to this practice was not strong except when scale was very large (for example the EBAP crew program in 1983). See more on lessons learned from slashing efforts in "Site Histories", Appendix. Over the years the effectiveness of slashing was debated; in 1982 the committee clarified its support of "selective" cutting of browse shrubs.
In 1999 the "melded" DLPAC committee stated support for a rate of up to 5 hectares per year for 4 years and then review regrowth of slashed shrubs.

- **Other forms of vegetation control (mowing)**

Generally supported within the DLPAC over the years, though not considered by all to be highly important or effective.

- **Planting conifers in certain locations**

A project to plant "fingers" of conifers on the lower flats was tentatively approved by at least one DLPAC meeting. Recent FOL proposal to plant Lot 570 cut blocks has not been discussed in a DLPAC forum.

- **Motorized Access**

There has always been consensus within the DLPAC about closure of the lower flats to motor vehicles (Lot 570 and south). During the 1980s there were significant access enforcements issues (cedar-poaching, motorbikes, etc). A formal-looking gate, signs, and at least one court case led to a gradual acceptance of the law on the south end of the property. More recently (1999) managers and the public recognized a need to limit access to the more recently-acquired Lot 881 behind Meadow Creek. This was proposed in the 1998 management plan (Poole et al) and the "melded" DLPAC of 1999 registered support for this, but no action has be taken. *At this time the road through that property is open and very well-used.*

During the early 1990s meetings the DLPAC discussed the potential future need to regulate recreational motor-boat/watercraft use around the lower delta. No concrete motions were passed or actions taken.

- **Water level management (along the Argenta slough)**

Throughout the early 1980s, the issue of water levels on the Argenta slough was controversial. Maintaining optimum conditions for beavers, waterfowl and turtles (on TNT Argenta marsh land) tended to flood out upstream farmer Roy Lake. Eventually an agreement was reached using a special culvert structure and a lot of volunteer time spent clearing beaver debris. Later in the 1980s there were further issues at the "Wasden causeway" that led to MOE-authorized killing of beavers and more heated controversy between MOE and the DLPAC/general public. There were many short-term motions passed by the DLPAC during this period in efforts to solve these problems. See "Site Histories" for more on the Argenta slough.

- **Acquiring more habitat on the floodplain**

The DLPAC was consistently unified in support of securing more wildlife habitat on the delta to complete the original vision; this was often reiterated at annual meetings. [3] Over the years the size of the protected habitat area slowly grew as Crown Lots 8895 and were was added to crown-

[3] When TNT started to purchase farm lands close to settlements, the local support for the initiative was less strong than it had always been previously for "the lower flats". (e.g. Block property Lot 881, and the Lake property most recently)

owned lots 16024 and 896, BC Hydro – owned Lot was amalgamated (informally), a small property on the east side of the flats was purchased in 1982 (the Argenta marsh). Efforts were made (unsuccessfully) to acquire the Lake property purchased in 1985. In the mid 1990s, the DLPAC recognized the potential future importance of including the "crown-owned foreshore" and active channel along the river as part of the wildlife area. Some of this got translated to a CORE "Goal 2" area. (*The Lake property has been subsequently purchased by TNT (2007)*

- **Trail access**

In the mid 1990s there was a request by the NAWC to build a short trail accessing the lower flats from the highway; no issue was taken, and this was accomplished. This trail remains open intermittently since that time. There is a system of old roads throughout the property for which there has never been any objection raised in DLPAC meetings about foot access use.

In contrast, there have been strong objections to the idea of constructing new trails (or to re-open/maintain game trails) into the "interior" of the property. This was one of the potential projects listed in the draft 1998 management plan (Poole et al 1998) that was rejected by the "melded" DLPAC (also not favoured by FWCP). The opposition to this was due to the perceived importance of security for wildlife in these same "interior" areas.

- **Logging**

This issue was highly controversial for a short duration, 1983 when MOE proposed and logged a patchwork of ½ hectare cut blocks in upper Lot 570. There were objections to the harvesting of the 2 patches near the river containing old growth. Since that time logging has not been proposed as a management tool. Poole et al (1998) proposed snag creation in by girdling in upper Lot 570; this was rejected by the 1999 melded DLPAC.

- **Management Plans**

There were 3 MOE-produced management plans reviewed by the original DLPAC (Silver 1978), Woods 1981, Woods and Super 1989). The 1999 "melded DLPAC" reviewed the 1998 draft plan (Poole et al) and composed a written response.

Additional miscellaneous activities instigated by the DLPAC

- Removal of old barbed wire fence
- Installed new gate
- Sign
- Placed "temporary" "Visitors please proceed on foot" sign at main entrance
- Goose nest platforms
- Duck nest boxes
- Home-made water level solutions

Concluding comments and recommendations

Some things worked well and some things did not. There are pros and cons to having a local advisory committee but overall there appear to be more "pros".

Things that DO (DID) and WOULD work

- At the outset, managers identifying key groups that they want to see represented (as done by MOE in 1979) then asking for nominations (rather than self-volunteering) [4]
- Members that want to learn new things (about a place, about other view points, etc.)
- Members with good communication skills
- A chairperson that is (a) neutral and (b) disciplined about calling meetings at least annually, recording minutes, etc. (c) is an extra good communicator, with both the FWCP/TNT managers and the local public (d) has time, and (e) preferably has extensive background relevant to area

Things that did not work (not recommended)

- Members with single track minds (minds made up) that are not interested in hearing (listening) to other view points.
- Members with no clear "constituents" and no actual reporting back and forth
- Selecting an advisory committee (e.g., the "new" one, in 1998)? at a meeting that represents only a certain contingent of the population, especially with no clear idea of ' stakeholders groups ' looking for.
- Chairpersons that take strong "positions"
- Managers providing insufficient time for DLPAC to have meaningful input in the case of major, contentious, operational plans, yet at the same time referring to the committee as being responsible for input. (This occurred in the case of the 1981 management plan and subsequent logging/slashing activities and in 1988 re: beaver-control permits. Both events caused great rancor between MOE and the DLPAC and public.)
- Managers feeling inhibited in "freedom to manage", by the DLPAC. This may have been the case in the late 1980s at times, with the source of conflict then being that most DLPAC members wanted less rather than more hands-on activities. ***Ironically, now, the opposite situation exists in which the local lobbying pressure is on the FWCP to do more, not less. This is occurring in the absence of a formal advisory group.***
- Managers not having any real measure of effectiveness (or goals) and no "follow-through" on enhancement actions taken. E.g. Did the logged openings and slashing activities in the 1981 management plan in fact "increase numbers of deer, elk , ducks and geese" as intended ?

Advantages of having a local advisory committee

- Reduces or eliminates "lobbying" of managers by single-interest groups.
- Provides information or advice at levels that would otherwise be unavailable to managers. On the social level, if members are in contact with constituents, an advisory committee gives managers a reading on public sentiment that would be unavailable otherwise. On a biological /technical level, at least some members of the committee can

[4] Key groups to be represented?: (1) adjacent landowners (reps, not total), (2) residents (local or Kootenay) possessing lots of factual knowledge about the area (3) consumptive recreational users, and (4) non-consumptive recreational users

potentially provide on-site stewardship, ("watchdog)/monitoring roles that would be lacking otherwise.

- Makes local residents feel more fairly/fully involved. A functioning advisory committee provides representatives for people to talk to on an ongoing basis.

Disadvantages

I can't think of any big ones except for the fact that it will take time.

Appendix 8: Other Land and Water Use Planning Initiatives

Protected Areas Strategy: Goal 2

In 1995 the Kootenay-Boundary Land Use Plan (KBLUP) set aside over 11% of the region as protected areas under the Protected Areas Strategy (PAS) Goal 1 objective. In 1998 a process was initiated to identify additional PAS 'Goal 2' protected areas (i.e., areas with Special Features). In 2002, both the Lardeau River and northern Kootenay Lake riparian ecosystems were approved by the Kootenay-Boundary Interagency Management Committee (IAMC) to be included on the 'A list' of 22 candidate areas for protection under PAS Goal. This includes the Crown-owned foreshore at the head of Kootenay Lake bordering the lower Duncan wildlife properties, and the active channel zone along the river throughout the Duncan wildlife properties.

Lardeau River Watershed Planning Initiative

With funding support from the Columbia Basin Trust, a local ecosystem watershed-based planning group (Friends of the Lardeau River) is working toward developing a Watershed Plan for the Lardeau River watershed. A watershed profile has been prepared (Nellestijn and Decker 2011) seeking to obtain protected status for vital and crucial fish and wildlife habitats along the Lardeau River corridor.

Duncan Dam Water Use Plan and Monitoring Activities

In December 2007, the Comptroller of Water Rights approved the final Duncan Dam Water Use Plan (DDWUP). Approval included an Order to implement the conditions proposed in the DDWUP and prepare Terms of Reference for monitoring programs and physical works. The Duncan Dam Water Use Plan Monitoring Program is designed to address key questions in support of decision making through the Duncan Dam Water Use Plan Consultative Committee (BC Hydro 2009).

In spring of 2009, BC Hydro began work on a number of 10-year monitoring projects aimed at improving understanding of how the river flow regime affects various ecosystem components. The long term goal is to adapt flow management to benefit biodiversity and other values, to the extent practicable. There are over a dozen monitoring studies along or in the lower Duncan River. The most pertinent are DDMON # 14, the monitoring of wildlife use within 100 meters of the active river channel of the lower Duncan River, and DDMON #8, the monitoring of cottonwood and other riparian vegetation within 100 m. of the active channel. These studies will collect data on some of the elements of biodiversity described in our report. For details on other studies, see http://www.bchydro.com/etc/medialib/internet/documents/environment/pdf/wup_duncan_dam_ddmmon0.Par.0001.File.DDMMON_8_TOR.pdf.

Preliminary studies include:

- DDMMON-8 Duncan River Watershed Riparian and Cottonwood Monitoring
- DDMMON-2 Lower Duncan River Habitat Use Monitoring
- DDMMON-12 Duncan Reservoir Archaeological Overview Assessment
- DDMMON-13 Duncan Reservoir Archaeological Site Erosion Monitoring
- DDMMON-14 Duncan River Watershed Wildlife Monitoring
- DDMWORKS-1 Lower Duncan River Argenta Slough Erosion Protection
- DDMMON-9 Lower Duncan River Mosquito Monitoring and Management Plan

Appendix 9: The Nature Trust Policy on Mosquito Control

LETTER OF UNDERSTANDING BETWEEN

DUCKS UNLIMITED CANADA, NATURE TRUST OF BRITISH COLUMBIA, AND NATURE CONSERVANCY OF CANADA

RE: MOSQUITO CONTROL IN BC WETLANDS

Whereas: Ducks Unlimited Canada (DUC) is a private, non-profit conservation organization dedicated to the perpetuation and increase of waterfowl resources through the restoration, preservation, and creation of wetland habitat in Canada.

And whereas: The Nature Trust of British Columbia (TNT) is a charitable organization dedicated to the conservation and preservation of areas of ecological significance in British Columbia.

And whereas: The Nature Conservancy of Canada (NCC) is a private, non-profit organization dedicated to the protection of areas of biological diversity in Canada for their intrinsic value and for the benefit of future generations.

And whereas: DUC, TNT, and NCC cooperatively manage lands for wildlife habitat in British Columbia. These lands can be potential sources of mosquitoes.

And whereas: Biting insects such as mosquitoes that are present in standing water can create a nuisance for landowners and specific species of mosquitoes can be vectors of the West Nile Virus.

And whereas: West Nile Virus (WNV) poses a threat to the health of Canadians and resources directed to reducing mosquito populations that transmit WNV need to be targeted to maximize mosquito control and minimize environmental degradation.

And whereas: All parties support a joint agreement on the control of mosquitoes on cooperatively managed lands.

It is agreed that:

1) Control of mosquitoes in a wetland should be approved for health and safety reasons and not for public nuisance.
2) Where a Medical Health Officer has identified a mosquito population within a conservation area and has determined that there is a risk to public health from

transmission of West Nile virus from mosquitoes to humans, mosquito population control measures may be undertaken

3) Approved control of mosquito should follow an integrated pest management plan including the use of a control substance that has the least harmful ecological impacts along with monitoring to determine if the vector for West Nile Virus is present.

4) In rural areas, the treatment of one wetland is not effective in reducing mosquito populations. The treatment of all mosquito sources would quickly exhaust resources and have little effect, as mosquitoes will move from uncontrolled areas into areas that have been controlled.

5) In urban areas, it is possible to reduce populations of mosquitoes in urban areas and preserve the health of wetland ecosystems, recognizing that the by-products of human activity (e.g., used tires, clogged rain gutters, discarded bottles and other containers, neglected bird baths and rain barrels) are also major contributors to the creation of mosquito breeding habitats favoured by mosquitoes that carry WNV.

6) The bacterial larvicide *Bacillus thuringiensis israelensis* (Bti) is preferred over the application of chemical larvicides that are toxic to fish and other aquatic invertebrates. Bti targets mosquito larvae with minimal effect on other organisms that live in wetland ecosystems.

THIS LETTER OF UNDERSTANDING is signed by the duly authorized signing officers of the parties effective on the day first above written.

_____	_____
Witness	Ducks Unlimited Canada
_____	_____
Witness	The Nature Trust of British Columbia
_____	_____
Witness	Nature Conservancy of Canada

Appendix 10: Agricultural Land Management – Detailed Proposed Actions and Priorities (see attached maps for DL 881 and for DL 12852/7450)