FRASER RIVER
ACTION PLAN

Status Report of Projects in Waste Management in the Livestock Industry in the Interior of British Columbia

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Status Report of Projects

in Waste Management in the Livestock Industry

in the Interior of British Columbia

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Fraser River Action Plan
Fraser Pollution Abatement Office
Environmental Protection
Environment Canada
Pacific and Yukon Region
224 West Esplanade
North Vancouver, B.C. V7M 3H7

Prepared by:
Dr. Klaas Broersma[1],
Dr. Paul Webb[2],
Mr. Bruce Roddan[1] and
Ms. Kathleen Wallach[2]

[1]Agriculture and Agri-Food Canada, 3015 Ord Rd., Kamloops, B.C. V2B 8A9 and
[2]University College of the Cariboo, Kamloops, B.C. V2C 5N3

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SUMMARY

The Status Report summarizes current activities undertaken by various British Columbia government agencies and other user groups in the Thompson-Nicola, southern half of the Cariboo-Chilcotin and north Okanagan-Shuswap regions of the Fraser River Basin that involve research, demonstration and monitoring projects in the area of pollution prevention and waste minimization in the livestock industry. The projects are largely concerned with identification of non-point source pollution, minimization of the impact of livestock waste, improving or maintaining water quality, and restoration of riparian zones, stream and surface water habitat for fish and wildlife through fencing to eliminate direct contact of cattle to water courses. The Status Report also provides information on cattle numbers and feedlots by region within B. C.,and potential manure production by cattle with emphasis on Thompson-Nicola and the southern half of the Cariboo-Chilcotin regions. It appends a list of selected projects and makes the following conclusions and recommendations.

CONCLUSIONS AND RECOMMENDATIONS

Feedlots and Confined Holding Areas (including winter feeding areas)

1. The environmental guidelines for beef producers and the best agricultural management plans appear to be sufficient guides to reduce or eliminate potential pollution from livestock in confined holding areas (winter feeding areas and feedlots) if fully implemented. These guides need to be further developed and refined by undertaking studies that have controlled treatments based on scientific method in B .C.'s interior,
2. Available information indicates that direct contact by livestock to water courses in conllned feeding areas result in contamination and decreased water quality. Direct contact of water courses by livestock should be eliminated in confined holding, feeding and feedlot areas (does not include rangeland grazing), and alternate remote watering methods be used.
3. Feedlots should have adequate land available to dispose of manure generated in the feedlots without polluting the soil and water courses with nutrients. The manure is a valuable resource of nutrients that should be utilized for forage or crop production.

4. Confined feeding or winter feeding areas should allow for proper disposal of manure by spreading or harrowing and not allow soils to become polluted with excess nutrient loads that can potentially leach into groundwater.
5. The Survey of Agricultural Practices in the Thompson Basin program by the B.C. Ministry of Environment, Lands and Parks to monitor and enforce pollution prevention and waste minimization measures is an effective tool to identify and reduce non-point source pollution. This program should be continued and enhanced in other regions.

Livestock Grazing on Rangeland

1. Further information is required from research studies designed to examine the effects of various land use activities, including livestock grazing, on water quality, to identify cause and effect relationships.
2. Most available information is highly industry specific. Further studies may benefit from a more integrated watershed approach to pollution identification and prevention.
3. Available information indicates that reduced stream bank vegetation on surface water courses resulting from various land use activities such as urbanization, forestry, agriculture (including livestock grazing), and recreation has resulted in significant erosion, deterioration in water quality, and fisheries and wildlife habitat. Maintenance and restoration programs for riparian zones and stream bank integrity need to be enhanced and encouraged at all community levels.

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1.0 INTRODUCTION

The rearing of livestock for beef is a major industry in the interior of British Columbia (B.C.). This industry, along with other resource based industries in B. C., is facing pressure from environmental and land use concerns to ensure long-term sustainability of natural resources such as rangelands, soil, water and air. The federal government's "Green Plan" provides a broad framework for change to ensure the long-term integrity of the environment. The Fraser River Action Plan (FRAP) is a component of the Green Plan initiative dedicated to developing sustainability of the Fraser Basin. The Federal-Provincial Committee on Sustainable Agriculture provided input to "Canada's Green Plan" and adopted the following definition of sustainable agriculture (Standing Committee on Agriculture 1992): "Sustainable agri-food systems are those that are economically viable, and meet society's need for safe and nutritious food, while conserving or enhancing Canada's natural resources and the quality of the environment for future generations, " The initiatives undertaken by the Green Plan culminated in the development of a list of factors and issues linked to the environmental sustainability of the agri-food sector. These issues include: agricultural soil resources, surface and ground water quality, wildlife habitat, air quality and climate change, genetic resources, pollution, and waste management. Although the cattle industry is affected by the development of sustainable agri-food systems, and has influence on all these issues, only the issues dealing with pollution and waste management will be addressed in this report. The beef industry, as a livestock and forage enterprise, if well designed and well managed can play an integral role in the production of food from renewable resources as part of the sustainable agri-food system. The interaction of livestock and forages is based on the physiological ability of ruminants to digest forages and the physiological ability of forage plants to withstand well managed grazing pressures. These two factors have contributed to the development of integrated livestock-forage systems in B.C. Consideration for the well-being of our natural resources of soil, water, fish, forests, and rangelands has become a major concern. The way the beef industry addresses these concerns is imperative as to how the public will view and perceive this industry in the future.

In the Klinck Lecture, *A World Turned Upsidedown* (Head 1991), it was stated that "in centuries past, incidents of environmental devastation were entirely the product of natural

phenomena far beyond the ability of humans to control but in recent years, however, these balances have changed. Nature is no less powerful, but today, human beings have become environmental factors. What has happened is that the human species in its quest for economic and physical advantage has become a potent destructive force, capable of undertaking activities of global magnitude." We must recognize and concede that our natural resource base of air, water, soil and vegetation, is threatened in many ways and that becoming more sustainable, is paramount ! Modern agriculture, including crop and animal production, can pollute streams and rivers and lakes with runoff from fields, feedlots and barnyards. Sustainable agriculture as defined by C.A. Gracey, a past executive vice-president of the Canadian Cattlemen's Association, is a commitment "to maintain and preserve our agricultural resource base of soil, water and atmosphere in such a state as to ensure that the capacity of future generations to feed themselves with an adequate supply of safe and wholesome food is unreduced''(Gracey 1989). The requirement for the reduced loading of pollutants through identification of sources and development and implementation of suitable prevention and management measurements is essential. It must not be imagined that sustainable agriculture is something new but that it has been in existence in the past. It has not been practised diligently lately and needs to be rediscovered. It is believed by many that well-managed livestock farms approach more closely what one would call sustainable agriculture, where land, livestock, forages and grains exist in a symbiotic balance. Dr. Carl Winter argues that animal agriculture is not merely a component of, but is essential to the long-term, sustainability of agriculture (in Gracey 1989, p24).

A considerable amount of published information is available from research, reviews and demonstration studies that have been conducted relating agricultural production (livestock grazing) and resource use response (Gifford 1980 and literature cited within). However, little information is available from well designed and controlled empirical studies examining specific cause/effect relationships. Much of the available information appears to come from studies that address problems without isolating relevant factors or having adequate controls and hence knowing the exact cause(s) of pollution.

Sustainability of natural resources is essential for long-term viability of the livestock-forage industry. If well designed and managed, the forage-livestock interaction is an integral

component of the sustainable agri-food system. In much of the available literature, various agricultural practices are often perceived as the main factor responsible for the deterioration of our natural resources, including water quality (Min. of Environment, Lands and Parks 1994; Young 1995). These perceptions are often based on observational and testimonial information without supporting concrete evidence. There are few watershed studies that have evaluated the interaction of livestock, soil and water in sufficient detail to allow a testing of the hypothesis that agriculture is the major factor in the deterioration of water quality considering other multiple land uses, such as, forestry, mining, urbanization, recreation and wildlife concentration within the same area. Additional, relevant information is required to further develop and refine management plans to reduce potential impacts of all factors resulting in the deterioration of water quality in watersheds.

2.0 STATUS REPORT

2.1 Purpose

The Fraser River Action Plan's (FRAP) aim is to reduce the loading of pollutants in the Fraser Basin through the identification of sources and the development and implementation of suitable prevention and management measures. Recognizing that the University College of the Cariboo (UCC) and Agriculture and Agri-Food Canada have an ongoing interest and expertise in evaluating various resource issues, including the beef industry, FRAP engaged UCC to undertake a study to examine the status of the projects and activities underway in the interior regions of B.C. Emphasis will be on the Thompson-Nicola and southern Cariboo-Chilcotin regions in the area of pollution prevention and waste minimization within the livestock industry.

2.2 Project Description

1. The project involved developing a status report on activities and initiatives related to the beef industry, in the area of pollution prevention, waste minimization and management, in the Thompson Region and the southern part of the Cariboo-Chilcotin Region of the Fraser River Basin. The report will focus on issues related to confined (areas where cattle are concentrated, eg. winter feeding or seasonal feeding areas and feedlots) operational practices of the beef industry. In this report, seasonal feeding is considered to be where cow calf operations confine

the herd onto a relatively small land base during late fall to early spring to feed with conserved forage which is locally grown or transported on to the farm. Manure is deposited by the cattle directly onto the soil while feeding and resting within the confined area.

2. For the Thompson Region, to estimate:

i) the total number of cattle in the region, .

ii) the average number of animal days for a "typical" seasonal feeding area, confined livestock area or feedlot, and

iii) the manure or nutrients generated (kg and/or tonne of nitrogen (N), phosphorus (P) and Biological Oxygen Demand (BOD)) for a "typical" seasonal feeding area, confined livestock area or feedlot.

3.0 METHODOLOGY

A wide range of working groups, agencies, and government departments in the Karnloops and part of the Cariboo-Chilcotin regions were contacted by phone and in person where possible, to interview relevant personnel to obtain information related to their activities in agricultural pollution prevention and waste minimization. These agencies included Ducks Unlimited, Kamloops Health Unit, Karnloops City Engineering, B.C. Ministry of Environment (Kamloops, Penticton and Williams Lake), B.C. Ministry of Forests (Kamloops and Williams Lake), B.C. Ministry of Agriculture, Fisheries and Food (Kamloops and Williams Lake), Department of Fisheries and Oceans, Environment Canada, Salmon River Watershed Resource Centre, Nicola Watershed Roundtable, and Shuswap Nation Fisheries Commission. Through the interview process relevant projects were identified and tabulated. Where possible, written and oral information was obtained detailing the nature of the project, objectives, anticipated results and outputs, and timeframes. In addition, most recent cattle census numbers and waste production information was obtained and calculated using published census reports from Statistics Canada, Census of Agriculture and the B.C. Ministry of Agriculture, Fisheries and Food, Brand Inspection Branch for the regions under study.

4.0 BACKGROUND INFORMATION

4.1 B.C.'s Rangeland

The forage and grazing resource in B.C. totals more than 10 million ha and consists of cultivated forage crops, native range (both grassland and forest land) and community pastures (Agriculture Canada 1989). Crown range, which is administered by the B.C. Ministry of Forests, accounts for about 85% of the area used for grazing in the province. Over most of this area, native grasses and forbs are the primary source of feed from late spring to fall, generally with no supplementation by other feeds. There are more than 330,000 cattle distributed among the six Forest Regions of B.C. The Kamloops and Cariboo Forest Regions account for close to 75% of the beef cattle. Crown land according to the B.C. Ministry of Forests (BCMF 1992; Wikeem et al. 1993) provides about a million allocated animal unit months (AUMS) [1] of grazing or about 60% of the total annual forage requirements (1,600,000 AUMS). The remaining 40 % (600,000 AUMS) is produced on about 1.5 million ha of private range, pasture and hay lands. It is on these private lands that confined feeding areas and feedlots occur.

Multiple resource uses occur in virtually all areas grazed by livestock on Crown land in B.C. The integration of forage and livestock functions with other management systems for our valuable resources such as timber, forage, water, fisheries and wildlife, and recreation, will continue to be a challenge. Good management standards are required in order to preserve watershed integrity, including water quality and quantity. Ruminants, such as cattle, utilize these resources by harvesting range and pasture plants, cultivated forages, crop residues, and weeds and convert them into food (ie. meat and milk). Animal food products such as milk and meat are high in essential dietary nutrients such as protein, vitamins and minerals. These products are of high quality and desirable to many people. The economic contribution of B.C.'S beef industry is significant with a generated income of over $125 million and generated employment of over 3000 person-years (Talisman 1989). Additional employment is generated by the slaughtering industry and the value of this industry has increased since 1988.

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[1] AUM is defined as the grazing required by the equivalent of 1 mature cow with 1 calf for one month.

4.2 Grazing Systems

Grazing systems represent a host of complex interactions along the soil-plant-animal continuum. These systems convert carbon dioxide, energy, water, and nutrients into plant material, which in turn provides a source of food for livestock, and hence up the food chain to humans. The manure or waste firom a properly managed grazing and feeding system is a valuable resource that re-cycles nutrients back through the soil-plant-animal system. Ideally, grazing systems can represent a closed or self contained sustainable system.

The direct environmental impact of livestock on a watershed where grazing occurs, is often difficult to assess. Most extensive grazing systems are found in areas that may not be suitable for other forms of agriculture due to soil chemical, physical, or climatic constraints and limitations. During the winter, non-intensive beef systems become more intensive beef systems as cattle are concentrated near the home base for winter feeding. Intensive systems generally have a greater potential to impact upon surface and groundwater quality. Therefore, the primary concern is on reducing or minimizing the impact of these operations through proper management practices.

Livestock production results in the production of waste, mainly as manure and urine. A small parcel of land of five hectares can be utilized to hold several thousand head of cattle in a feedlot or fewer cattle if it is a confined feeding area. The number of cattle that can be held or confined in an area should be dependant on the amount of land available to dispose of the manure produced utilizing acceptable disposal levels and procedures. During the late spring, summer and early fall grazing season much of the manure produced is spread extensively over the landscape during grazing. In winter with confinement (November-December till May) concentrations of wastes produced are confined within much smaller areas that have a potential as non-point sources of pollutants. Management of large quantities of animal wastes with minimal impact on air, soil and water is a major challenge for livestock operators.

4.3 Legislation

Agricultural operations, such as cattle producers are under the influence of local, provincial and federal environmental legislation. Each level of government has legislation and regulations to prevent pollution and nuisances. There are several non-regulatory programs

supporting producers in meeting the various legislative requirements and encourage the implementation of farm practices that benefit and protect the environment.

The Municipal Act, allows local governments to enact and enforce a variety of land use plans and zoning by-laws. Zoning by-laws may specify setbacks for buildings from lot lines to reduce conflicts with neighbors while setbacks from water courses are intended to alleviate pollution of water courses.

At the Provincial level, five Ministries administer Acts that impact on farming practices. These include: the Municipal Act of the Ministry of Municipal AfTairs, Recreation and Culture; the Health Act of the Ministry of Health; the Waste Management Act (Agriculture Waste Control Regulation and Code of Agricultural Practice for Waste Management) and Pesticide Act of the Ministry of Environment, Lands and Parks; the Agricultural Protection Act of the Ministry of Agriculture, Fisheries and Food and the Highways Act administered by the Ministry of Transportation and Highways. In addition, the new Forest Practices Code administered by Ministry of Forests will also play a major role in land use decisions affecting livestock grazing. The Municipal Act gives local governments the authority to write by-laws that control the use and development of land and control nuisances. The Health Act regulates farm practices that maybe a health hazard. The Waste Management Act is responsible for and has jurisdiction over pollution resulting from the agriculture industry. The Pesticide Control Act applies to the sale, transportation, storage, preparation, application and disposal of pesticides. The Agriculture Protection Act protects cattle producers within the Agricultural Land Reserve against unwarranted nuisance suits as long as the operation is in accordance with generally accepted farming practices and complies with other relevant local, provincial and federal legislation related to farming. The Highways Act affects unlawful activities related to noxious or filthy substances or dead animals left on the road right-of-way.

At the Federal level the Fisheries Act is enforced by Environment Canada and Department of Fisheries and Oceans. This is the main Federal Act that can address pollution in cases where farming practices result in the deposit of deleterious substances into water frequented by fish or water that may eventually enter fish bearing habitat. Manure and contaminated runoff water from

overwintering and feedlot areas are materials that can fall into this classification when improperly managed.

There are also several non-regulatory and self-regulatory programs in place to support producers. These programs assist producers to comply with the various legislative acts and regulations and encourage the implementation of farming practices that protect water courses and other components of the environment. Plans, tools and programs developed under the B .C. Ministry of Agriculture, Fisheries and Food include: Best Agricultural Waste Management Plan, Best Soil Management Plan, Agricultural Land Development Assistance (ALDA) and The N Behaviour Simulation Computer Model. The B.C. Federation of Agriculture adopted and endorsed environmental sustainable production practices with the establishment of the Agricultural Environmental Protection Council to work directly with the producers. Government agencies have not delegated any legislative authority or responsibility to the Agricultural Environmental Protection Council but are generally willing to work with this council to remedy pollution problems and unsuitable practices before stepping in with regulatory action.

A Best Agricultural Waste Management Plan provides waste management suggestions to cattle producers with pollution concerns that could result from dead animals, livestock feed, manure, and yard runoff. By addressing the concerns outlined in the plan, producers are considered to be in compliance with all provincial environmental laws and regulations. A Best Soil Management Plan is intended to provide recommendations for farms that have wide ranging problems. The N Behaviour Simulation Computer Model simulates N behaviour from the time it is excreted by the animal. This model can be utilized as a tool to help with manure management practices and predict potential environmental contamination. The Agricultural Land Development Assistance (ALDA) Program provides low interest loans for on-farm capital improvements such as those that improve soil and water quality.

The Agricultural Environmental Protection Council formed in 1990 is a “self regulatory model” being used to resolve nuisance and pollution “complaints against agricultural operations before regulatory intervention (BCMAFF 1992b, pp. 59-60). Use of qualified peer producers to explain the concerns and help find solutions, in a timely manner, to an individual producer’s environmental problems in theory should result in not having to deal with the regulatory agencies.

Only those operations that continue with unacceptable and harmful environmental practices will be addressed by government regulatory agencies.

5.0 THOMPSON REGION CATTLE NUMBERS AND MANURE PRODUCTION

The main agricultural activity in the Interior regions of B.C. (Figure 1) is the beef cattle industry. Of the total number of cattle in the Cariboo and Thompson-Okanagan regions, 97 and 90% respectively, are beef cattle. In the Thompson-Okanagan region approximately 10% of the cattle are dairy cattle. There are fewer dairy cattle in the Cariboo region, and within the Thompson-Okanagan region most are concentrated in the North Okanagan area. Most of the cattle are grazed on Crown range from approximately the middle of May to the end of October. In the Thompson-Okanagan region cattle feeding does not generally begin until December, depending on snow conditions and feed availability. In the Cariboo region winter feeding starts earlier and finishes later in comparison to the Thompson-Okanagan region as the climate is more severe mainly because of increased elevation Therefore, a standard winter feeding period in terms of the number of animal days is difficult to establish. Feeding generally occurs for a minimum of about 150 days from around December 1 till May 1.

Total cattle numbers within B.C. have increased 9 % from 689,957 head in 1989 to 752,414 in 1991 (Table 1). The increase is mainly within the beef sector where total beef cow numbers have increased from 214,670 head in 1989 to 242,742 head in 1991 or 113 % of 1989. The dairy cow numbers decreased ever so slightly (-O. 1 %) from 75,005 to 74,919 head over the same time period. Excluding beef and dairy cows, other cattle increased from 400,282 head to 424,753 head, a 8.6% increase. The increase in beef cattle numbers occurred mostly in the northern part of the province with the North Central (31 %) and Peace regions (41 ‘%). The total cattle numbers in the Thompson-Okanagan remained the same while within the Cariboo region cattle numbers increased by 10,436 head, mostly within the beef herd (49%). The total number of calves (cattle under the one year old) between 1988 and 1992 ranged between 95 and 104 % of the total beef cows (BCMAFF 1992a, Table 60). Most of the calves are sold from the ranches in the fall when cattle come in from the range. Assuming that all calves are sold and

Figure 1. Location of project sites in the Cariboo-Chilcotin, Thompson-Nicola and Okanagan-Shuswap regions.

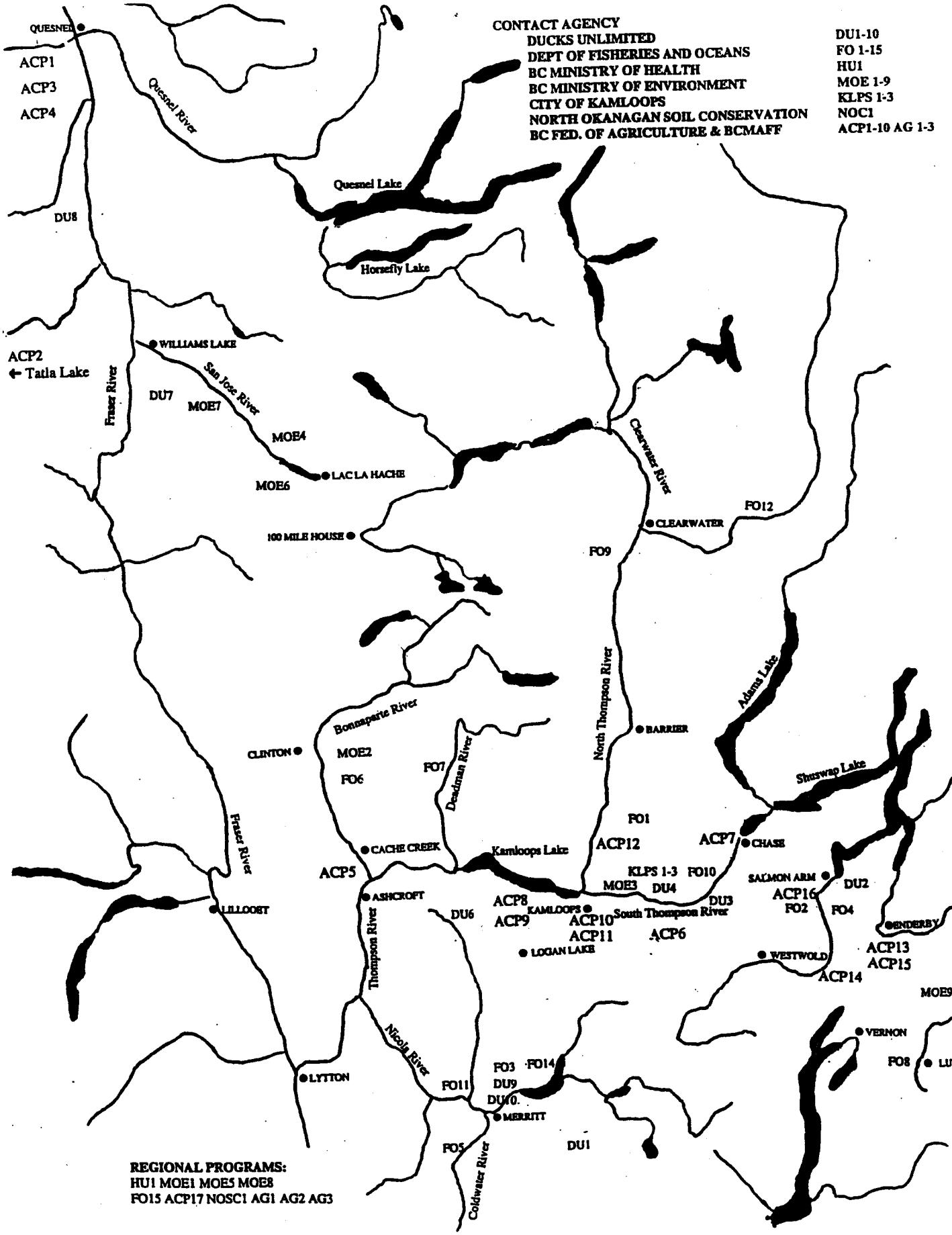

Table 1. Head of beef cows, dairy cows and total cattle on farms by region for 1986 and 1991.

Region	Year	cows		
		Beef Cows	Dairy Cows	Total Cattle[z]
South Coast	1986	15043	59314	172520
	1991	*17264*	60862	175702
Thompson-Okanagan	1986	72634	8296	203166
	1991	72279	7506	203106
Kootenay	1986	20092	1961	50692
	1991	21765	1550	53637
Cariboo	1986	56841	1698	138740
	1991	61915	1762	149176
North Central	1986	18293	2067	47537
	1991	23962	1923	62028
Peace	1986	31767	1669	77302
	1991	45557	1316	108765
Total	1986	214670	75005	689957
	1991	242742	74919	752414

Source: Ministry of Agriculture, Fisheries and Food, Census of Agriculture 1986 and 1991.

transported out of B.C. in the fall would bring total cattle numbers down to 131,000 and 87,000 head during the winter for the Thompson-Okanagan and Cariboo regions, respectively.

The ranching industry of B.C. only has small numbers of cattle that are kept in feedlots compared to the province of Alberta. In 1989 the total number of feedlots in B.C. amounted to 101, with a capacity of just over 85,000 head (Table 2) or 850 head per feedlot. The actual number of cattle in these feedlots in December was considerably less at just over 58,500 head or less than 70 % of capacity in 1989. The number of cattle in feedlots has continued to decrease

[2] Total cattle includes all beef and dairy cattle (cows, heifers, steers, bulls, etc.).

from 1988 to 1991, the last year a feedlot survey was conducted (personal communication, Brand Inspection Branch, BCMAFF, Karnloops, May 1995). Cattle numbers in the feedlots are generally highest during the winter. In the Mainland-Southwest and Thompson-Okanagan regions cattle numbers for June 1990 amounted to about 6500 and 4000 head, respectively considerably lower than winter. The greatest concentration of feedlots occurs within the Thompson-Okanagan region where 52 or half of the total feedlots are located. The number of cattle in the Thompson-Okanagan region feedlots account for 65 % of all feedlot cattle in B.C. The average size of the feedlots within the Thompson-Okanagan region amounts to about 1085 head.

The generation of manure is considered by many as strictly a waste disposal issue and the materials are not to be looked upon as the valuable resource of nutrients and organic matter that it really is. For centuries farm manure was synonymous with successful, stable and sustainable agriculture, but that has not been the case lately. The manure produced by farm animals under confined conditions can lead to problems if not enough suitable land is available for its ultimate disposal or if the manure is not stored properly to prevent leaching and runoff. This would be synonymous with urban settlements not having adequate facilities to handle and treat storm waters and domestic sewage.

Table 2. B.C. feedlot numbers, number of cattle in feedlots and feedlot capacity 1989.

Region	Number of Feedlots 1989	Feedlot Capacity 1989	December Feedlot Cattle Numbers 1988	1989	1990	1991
Vancouver Island/Coast	o	0	0	0	0	0
Mainland/Southwest	23	16550	10952	9355	7763	7840
Thompson/Okanagan	52	56425	38632	40001	40221	36827
Kootenay	11	2845	*2440*	2342	2098	2912
Cariboo	7	2525	*15.47*	1835	1912	2015
North Coast	0	0	*0*	0	0	0
Nechako	5	2380	*1587*	1990	1942	2393
Northeast	3	4400	*3750*	3050	3150	2475
Total	**101**	**85125**	**58908**	**58573**	**57086**	**54462**

Source: BCMAFF (1995) Brand Inspection, personal communication, Kamloops, B. C..

According to Brady (1990) a 20,000 head feedlot operation produces about 36,000 Mg(3) of manure on a dry matter basis annually. The manure from such a feedlot after partial decomposition and moisture loss and when spread at 22 Mg ha-l would require 1440 ha of land. The enormity of the potential disposal is obvious for these types of operations. If the same assumptions and calculations used by Brady above are applied, using manure degradation of 1570 due to decomposition and moisture, it would require on average only about 60 ha of land to dispose of the manure for each of the 100 feedlot operations at 1989 potential capacity (850 head per feedlot). The actual average for 1989 was 580 head per feedlot considerably less than its potential. Within the Thompson-Okanagan region the average feedlot capacity, using 1989 information, is considerably larger at close to 1100 head, and typical feedlots within this region would therefore require about 75 ha of land to dispose the manure generated. This would be a maximum estimate as most feedlots are under utilized during most of the year. Maximum feedlot numbers occur during the winter. A more accurate estimate of land requirements for a feedlot would be between 50 and 75 % of the estimated full capacity because of actual lower total annual cattle numbers.

The environmental guidelines for beef producers in B.C. (BCMAFF 1992b, Chapter 9, see Appendix 12.0) has an example calculation to determine the necessary area for spreading beef cattle manure. The type of crop receiving the manure and region of the province has to be taken into account in addition to cattle numbers, cattle weight and number days cattle are confined. The example in this report has been not been corrected for 500 kg animals as 455 kg is only 5 kg difference. Comparing two crop types, perennial grass and silage corn, the amount of land needed to spread manure from a 1100 head feedlot in the Karnloops region can be calculated to be: hectares land required if crop is perennial grass,

$$\frac{\text{Animal Days x Spreading Area Coefficient}}{\text{10,000 x O.M. Adjustment Factor}} = \frac{\text{1100 head x 150 days x 4.3}}{\text{10,000 x 1.2}} = 65 \text{ ha}$$

Hectares of land required if crop is silage corn,

$$\frac{\text{Animal Days x Spreading Area Coefficient}}{\text{10,000 x O.M. Adjustment Factor}} = \frac{\text{1100 head x 150 days x 6.1}}{\text{10,000 x 1.2}} = 92 \text{ ha}$$

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[3] M g = 1,000,OOOg= 1,000,OOOgx 1 kg x 1000 g-1= 1000 kg or 1 tonne.

Above calculations are based on spreading area coefficients of 4.3 and 6.1 for perennial grass and silage corn, respectively for Okanagan Thompson based on hectares per 10,000 animal days on feed. Soil organic matter (0. M.) was estimated to be between 5 and 10 % therefore the adjustment factor was set at 1.2 (Appendix 2, pp 130-132). The 65 ha hectares required compares quite favorably with the calculations from Brady (1990) of 75 ha. For more detailed explanation of the calculations and factors used see Appendix 2.

Manure deposited directly by the animal to a field is a combination of faeces and urine but from a confined feeding area or feedlot it also includes bedding and feed wastage. The nutrient content of manure is dependent on the animal type, diet and degree of contamination by feed and bedding. Manure chemical composition is therefore variable and difficult to determine accurately. Tables 3,4 and 5 indicate the variability in the chemical composition of manure. The reported Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of fresh manure was 1.6 and 7.8 kg day-l respectively for a 360 kg beef animal (Hagen 1990). On this basis, fresh manure from a mature 500 kg beef animal would have an approximate BOD of 2.2 kg day^{-1} and a COD of 10.8 kg day-i. The total N content of manure ranged from 0.2 to 0.670 and the P from 0.06 to 0.21 % (Tables 3,4 and 5). For this study the nutrient content of the beef manure from the North Okanagan Soil Conservation Group with 0.4 % N and 0.21 % P will be used (Table 3). The N content is reasonably similar to USA values as is the P. The N and P appear to be lower compared to Alberta feedlots. In feedlots the N and P content is higher as higher quality feed is used for finishing rations than for the maintenance of a cow herd.

Table 3. Composition of manure from North Okanagan region.

Characteristic	Beef		Dairy	
	Solid manure	SD	Solid manure	SD
Dry matter %	32.21	9.7	22.79	7.1
Total N %	0.42	0.16	0.40	0.12
Organic N %	0.40	0.15.	0.36	0.12
Ammonium ppm	168	236	466	502
Phosphorus %	0.21	0.15	0.15	0.06
Potassium %	0.68	0.29	0.72	0.27
Magnesium %	0.16	0.07	0.13	0.09
Sulfur %	0.08	0.04	0.08	0.03

Source: Bevandick I.M. 1994. Final Report of the North Okanagan Soil Conservation Group. Canada-BC Soil Conservation Program. 22p.

Table 4. Moisture and nutrient content of manure from beef and dairy cattle USA.

Animal	Faeces/urine ratio	H2O	Total Nutrients (dry wt. basis)		
			N	P	K
			%		
Feeder cattle	80:20	85	0.6	0.10	0.30
Dairy cattle	80:20	85	0.5	0.06	0.31

Source: Brady N.C. 1990.

Table 5. Characteristics of cattle feedlot manure in southern Alberta.

Characteristic	Mean	SD
pH	7.2	0.3
EC(dS m^{-1})	23.0	6.6
Available P (kg Mg^{-1})[4]	8.0	2.3
Water content (kg Mg^{-1})	825.9	217.9
Organic matter (kg Mg^{-1})	283.5	99.1
Total N (kg Mg^{-1})	15.8	4.3
Soluble salts (moles Mg^{-1})		
Na	171.5	58.4
Ca and Mg	35.3	18.5
$S0_4$	32.1	14.3
NH_4-N	193.8	72.6
NO_3-N	8.0	10.4

Source: Chang C. and T.G. Sommerfeldt. 1993.

Manure production per 500 kg animal as dry matter has been estimated to be between 5.5 and 6.8 kg day^{-1} (C. Chang, personal communication, Agriculture and Agri-Food Canada, Lethbridge, AB., March 20, 1995). Estimations from Brady (1990) would put dry manure production at 5 kg day^{-1} of dry matter for a similar size animal [(5)]. These estimates are just a little higher than reported in the "Environmental guidelines for beef cattle producers in B. C." at 29 kg moist manure day^{-1} as excreted by a 500 kg animal (4.35 kg dry manure day^{-1}) (13 CMAFF 1992b).

[4] Mg = 1 tonne or 1000 kg. To calculate % use kg Mg^{-1} * Mg / 1000 kg * 100 or (* O. 1).

[5] Cattle manure is composed approximately of 80:20 ratio of faeces to urine and has a water content of 8570, therefore 5 kg of dry manure is equal to 33.3 kg of moist manure.

Total cattle numbers, which includes calves, is generally about 200,000 head for the Thompson-Okanagan region using Census information which is collected in June. Assuming that all animals are actually mature, the regional yearly dry matter manure production would amount to: 200,000 head x 5 kg manure day^{-1} x 365 days $year^{-1}$ = 365,000,000 kg of manure $year^{-1}$. Total N and P in this manure would amount to 1,460,000 kg N and 766,600 kg P annually. However, actual mature cattle numbers would be closer to 131,000, as calves are sold out of B.C. in the fall. Since mature cattle are only in a confined feeding situation for about 150 days out of the year, only 40% of the annual manure generated and associated nutrients would be collected in confined feeding or feedlot areas. The estimated dry matter manure, produced during winter confinement would then amount to: 131,000 head x 5 kg manure day^{-1} x 150 days $year^{-1}$ = 98,250,000 kg, and includes 393,000 kg N and 206,325 kg P. Therefore, for the Thompson-Okanagan region estimates indicate that:

i) the total number of cattle in the region amount to 200,000 head in the spring and 131,000 head in the winter,

ii) the average number of animal days for a "typical" seasonal feeding area, confined livestock area or feedlot amounts to about 150 days annually, and

iii) the total regional waste generated (kg and/or tonne of N and P) by "typical" seasonal (150 days) feeding in confined livestock area and/or feedlot operations would amount to 98,250,000 kg manure, and includes 393,000 kg N and 206,325 kg P, annually. The BOD would amount to 2.2 kg day^{-1} $head^{-1}$ x 131,000 head = 288,200 kg day^{-1}

vi) for a "typical" 770 head feedlot (or confined feeding area), the total waste generated over winter (150 days) would be 577,500 kg and includes 2,310 kg N, 1,212 kg P, and 254,100 kg BOD and 1,247,400 kg COD.

Disposal of this manure at the rate of 22 Mg ha^{-1} would require 4500 ha of land or applying at half the rate one would require just over 9000 ha of land.

6.0 PROJECTS AND PROJECT STATUS

The following tables list the status of current projects by agency in the Thompson and Cariboo-Chilcotin and Okanagan-Shuswap (see APPENDIX 11.0 for project details).

Table 6. Project titles and project status

No	Project Title	Status		
		Type	Complete	Ongoing
	Ducks Unlimited			
1	Riparian Enhancement Study	Monitoring Study		*
2	Salmon Arm Indian Lands	Restoration	*	
3	Fallis Pond	Restoration	*	
4	South Thompson Riparian	Restoration		*
6	Tunkwa	Restoration	*	
7	Frost Creek	Restoration	*	
8	Buckskin Complex	Restoration	*	
9	Nicola River Corridor	Monitoring Study		*
10	Nicola River Corridor Study	Restoration		*
	Department of Fisheries and Oceans			
1	Lois Creek Watershed Restoration	Restoration		*
2	Salmon River Watershed Restoration	Restoration		*
3	Nicola River - Sherman Channel	Restoration	*	
4	Salmon River - Hampshire Channel	Restoration		*
5	Coldwater River - Eaton Channel	Restoration		*
6	Bonaparte River	Restoration		*
7	Deadman River	Restoration		*
8	Duteau Creek	Restoration		*
9	Lernieux Creek	Restoration		*
10	Shuswap River	Restoration		*
11	Nicola River	Restoration	*	
12	Mad River	Restoration	*	
14	Nicola River Temperature Monitoring	Monitoring Study		*
15	Stewardship of Waterways and Wetlands Guide	Education Guide		*

Table 6. Continued.

No	Project Title	Type	Status: Complete	Status: Ongoing
Ministry of Health				
1	Water Sampling Analysis System	Monitoring Study		*
Ministry of Environment, Lands and Parks				
1	Criteria for Water Quality (1994)	Monitoring Study		*
2	Water Quality Objectives - Bonaparte River	Monitoring Study		*
3	Water Quality Objectives - Thompson River	Monitoring Study		*
4	Water Quality Objectives - Williams Lake San Jose River	Monitoring Study		*
5	Okanagan Water Quality Project	Monitoring Study		*
6	Phosphorus Sources Lac La Hache Drainage Basin	Monitoring Study	*	
7	Phosphorus Sources San Jose River Basin: Effects of Winter Livestock Management Practices	Monitoring Study		*
8	Survey of Agricultural Practices in the Thompson Basin (1994)	Monitoring Study		*
9	Water Quality Objectives-Shuswap-Mabel Area Bessette Creek	Monitoring Study		*
City of Kamloops				
1	Watershed Management Study	Monitoring Study		*
2	South Thompson River Turbidity Monitoring Program	Monitoring Study		*
3	South Thompson River Water Quality Monitoring Program	Monitoring Study		*
North Okanagan Soil Conservation				
1	Final Report NOSCG	Study	*	

Table 6. Continued.

No	Project Title	Join		
		Type	Complete	Ongoing
BC Federation of Agriculture & BC Min. of Agric., Fisheries and Food				
1	1994E09 ARDCORP	Pollution Abatement		
2	1994E11 ARDCORP	Pollution Abatement		*
3	1994E16 ARDCORP	Pollution Abatement		
4	1994E18 ARDCORP	Pollution Abatement		
5	1994E43 ARDCORP	Pollution Abatement		
6	1994E13 ARDCORP	Pollution Abatement		
7	1994E33 ARDCORP	Pollution Abatement		
8	1994E41 ARDCORP	Restoration		
9	1994E48 ARDCORP	Pollution Abatement		
10	1994E50 ARDCORP	Pollution Abatement		
11	1994E56 ARDCORP	Pollution Abatement		
12	1994E05 ARDCORP	Pollution Abatement		
13	1994E23 ARDCORP	Pollution Abatement		
14	1994E25 ARDCORP	Pollution Abatement		
15	1994E27 ARDCORP	Pollution Abatement		
16	1994E58 ARDCORP	Pollution Abatement		
17	AG 1 Agricultural Environmental Protection Council	Peer Regulation		
18	AG 2 BCMAFF Water Management and Intensive Land Use Activities	Extension/Technical Support		*
19	AG 3 Non-Government Funded Projects	Industry Projects		*

7.0 DISCUSSION

The issue of animal waste disposal from beef cattle production in the central interior of B.C. is of particular concern in relation to i) maintaining water quality acceptable for human and animal consumption and ii) maintaining acceptable water quality for fisheries under the two common animal production systems of grazing livestock on rangeland with access to water courses and the concentration of livestock in confined winter feeding or over wintering sites and feedlots. It has been well documented that animal wastes can contribute to water pollution if

proper waste management is not practised (Loehr 1968). However, it is much more difficult to determine on a watershed basis versus site specific basis (point source) the relative contribution to a deterioration in water quality from domestic livestock, considering that other uses of the land base such as forestry, mining, recreation, urbanization, transportation and wildlife concentration can significantly affect both water quantity and quality (Coltharp and Darling 1975).

Most of the scientific literature dealing with livestock waste and the effects of livestock waste disposal on water quality focuses on feedlot and confined holding areas. In the dry interior, runoff from these areas is intermittent and is mainly a seasonal event during snow melt or after heavy rainfall. Runoff may contain high microbial populations and nutrients such as nitrate, ammonia and phosphorus (P), among other potential pollutants, that can affect human health, water quality and fish. Runoff can be a source of pollution if not properly contained (Diesch 1970). In the Kamloops and Cariboo-Chilcotin regions there are two primary areas of water quality concern related to human consumption, turbidity and microbial organisms (eg. *Giardia lamblia)* as these are not eliminated by traditional chlorine treatment (City of Kamloops, Engineering Dept.). Zebarth (1992) reviewed water quality issues and research in B.C. and concluded that in non-irrigated areas with a low annual rainfall such as the Interior of B. C., in general, precludes the leaching of nutrients as a concern. Similarly, pesticide usage is low in the interior and leaching of pesticides to surface or ground water is not a concern. According to Zebarth (1992) most research in the area involves soil fertility management for forage. Studies of manure application to seasonal feeding areas undertaken by the North Okanagan Soil Conservation Group (Bevandick 1994) have shown little evidence of nitrate-N or P percolation from soil samples collected in the fall and spring to a depth of 60 cm. Surface runoff was the main source of contamination to watercourses followed by direct access by cattle. Water contamination from cattle with N, P, and faecal coliform was noted whenever there was unlimited access to a water course during runoff conditions. The greater the runoff volume the greater the contamination. Nagpal (1992) described studies undertaken by Hart and Mayan (1990) to examine the effects of cattle over-wintering sites on high levels of P in runoff to the San Jose River and contributing to the eutrophication of Williams Lake. They observed that even though no quantitative studies were completed and no other industries considered, that the agricultural areas surrounding the mainstem (some 62 cattle over-wintering sites) were the major source of P

loading to the San Jose River. The Borland Creek watershed a tributary of the San Jose river was the next largest contributor of P loading. To reduce these impacts on Williams Lake the Ministry of Environment, Lands and Parks are working with ranches to reduce impacts to meet water quality objectives set for the San Jose watershed (Nagpal 1993). This report did determine that feedlots (=770 head) and likely confined feed areas would generate in excess of 577,000 kg of manure (dry basis) and 1212 kg P during the winter.

The Ministry of Agriculture, Fisheries and Food and the B.C. Federation of Agriculture have produced environmental guidelines for beef production (BCMAFF 1992b). The pollution potential of feedlots and confined holding and feeding areas can be reduced and possibly eliminated by following the recommendations outlined in the guidelines for beef producers and ensuring best agricultural management plans are developed and implemented for specific operations. These guidelines need to be further bridged with solid scientific knowledge and verified for the Thompson region as in the North Okanagan Soil Conservation Program and the San Jose watershed studies.

According to Gifford (1980), very little information is available on the effects of livestock on rangeland water quality even though several authors have reported that livestock overgrazing increases microbial populations, biological oxygen demand, nutrients, water temperature, and turbidity (Meehan and Platts 1978). Livestock grazing can have significant effects on rangeland watershed hydrological behaviour by the removal of protective plant cover and by trampling disturbance (Gifford 1980). Overgrazing can lead to reduced protective cover, increased raindrop impact, lowering of soil organic matter, decreased infiltration rates of precipitation, increased runoff and possible erosion (Smeins 1975; Blackburn 1975; Gifford 1975; Meeuwig and Packer 1976; Wood et al. 1978). In British Columbia, the main concern with contaminated surface runoff is its effects on aquatic habitats and in particular fish populations. In non-treated contaminated surface water, BOD (biochemical oxygen demand), nutrient loading (N, P, and other nutrients), heavy metals, faecal coliform and faecal streptococci tie of concern for both animal and human consumption, as well as for lake and stream ecology including fisheries. The sparsity of scientific information in this area@ highlighted in by Behnke and Zarn (1976) who stated “The need for more precise data on the relationships of livestock density and grazing techniques to soil, climate, vegetation and impacts on stream environments and fish populations

must be considered as the highest research priority to provide a sound basis for management decisions which will resolve the conflicts between livestock grazing and fish habitat quality". In addition, the Fraser Basin Management Plan (FBMP) report card on non-point source pollution states that "The dispersed nature of non-point source pollutants makes them difficult to regulate and manage, data on non-point source pollution is limited and the magnitude of the problem is not well understood" (FBMP 1995).

Most work in the Thompson and Cariboo-Chilcotin regions (see APPENDIX 11.0) involves demonstration and monitoring projects that are concerned with the restoration of riparian zones, and improving stream and surface water habitat for fish and wildlife through the reestablishment of riparian vegetation and fencing to eliminate direct contact to water courses by cattle. Some exceptions include evaluating contaminated surface runoff and water quality.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Feedlots and Confined Holding Areas (including winter feeding areas)

1. The environmental guidelines for beef producers and the best agricultural management plans appear to be sufficient guides to reduce or eliminate potential pollution from livestock in confined holding areas (winter feeding areas and feedlots) if fully implemented. These guides need to be further developed and refined by undertaking studies that have controlled treatments based on scientific method in B .C.'s interior.
2. Available information indicates that direct contact by livestock to water courses in confined feeding areas result in contamination and decreased water quality. Direct contact of water courses by livestock should be eliminated in confined holding, feeding and feedlot areas (does not include rangeland grazing), and alternate remote watering methods be used.
3. Feedlots should have adequate land available to dispose of manure generated in the feedlots without polluting the soil and water courses with nutrients. The manure is a valuable resource of nutrients that should be utilized for forage or crop production.
4. Confined feeding or winter feeding areas should allow for proper disposal of manure by spreading or harrowing and not allow soils to become polluted with excess nutrient loads that can potentially leach into groundwater.

5. The Survey of Agricultural Practices in the Thompson Basin program by the B.C. Ministry of Environment, Lands and Parks to monitor and enforce pollution prevention and waste minimization measures is an effective tool to identify and reduce non-point source pollution. This program should be continued and enhanced in other regions.

8.2 Livestock Grazing on Rangeland

1. Further information is required from research studies designed to examine the effects of various land use activities, including livestock grazing, on water quality, to identify cause and effect relationships.
2. Most available information is highly industry specific. Further studies may benefit from a more integrated watershed approach to pollution identification and prevention.
3. Available information indicates that reduced stream bank vegetation on surface water courses resulting from various land use activities such as urbanization, forestry, agriculture (including livestock grazing), and recreation has resulted in significant erosion, deterioration in water quality, and fisheries and wildlife habitat. Maintenance and restoration programs for riparian zones and stream bank integrity need to be enhanced and encouraged at all community levels.

9.0 ACKNOWLEDGEMENTS

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APPENDICES

APPENDIX1

1.1 DUCKS UNLIMITED PROJECTS

PROJECT TYPE

Monitoring study.

PROJECT TIME FRAME

Date initiated: 1993
Date completed:

PROJECT LEADER

Astrid Van Woudenberg
288 Whiteshield Crescent
Kamloops B.C. ph(604) 374-0197

LOCATION/TYPE OF LITERATURE /DOCUMENTS

see project leader

SUBJECT/ABSTRACT

This study monitors changes in riparian vegetation, populations of small mammals, reptiles, amphibians and birds in response to the exclusion of livestock grazing.

PROJECT COLLABORATORS

BC Conservation Foundation, Interior Wetland Program (IWP)and Habitat Conservation Fund (HCF).

CLIENTS/AUDIENCE

Livestock producers and riparian habitat managers.

OBJECTIVES

To monitor responses of a riparian zone to exclusion of livestock grazing.

BACKGROUND AND NEED

Project was initiated by BCMELP through the HCF. Needs relate to the protection and enhancement of riparian habitats and biodiversity on rangelands used for grazing livestock.

METHODOLOGY/APPROACH

A two year baseline assessment of a riparian zone using vegetation plots to observe plant and vertebrate populations was conducted during which cattle were allowed to graze uninhibited by fencing controls. Fences were then built to exclude cattle from the experimental sites and observations of population changes will be conducted over several years.

ANTICIPATED OUTPUTS

Progress and major bench mark reports; recommendations regarding grazing management.

RESULTS TO DATE

Baseline assessments.

BUDGET

$120,000/year.

PROJECT TYPE

Demonstration project .

PROJECT TIME FRAME

Initiated: 1992
Completed: 1993

PROJECT LEADER

Ian Barnett
District Manager
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Kamloops B.C. V2C 5P5

LOCATION/TYPE OF LITERATURE

File #2753 Ducks Unlimited Karnloops

SUBJECT/ABSTRACT

Wetlands on Salmon Arm Indian Lands area significant waterbird migratory stop and breeding area. Enhancement and improvement of habitat will increase populations of wildlife and fish. The relatively poorly managed cattle grazing is a threat to the sites. Better management through the use of fencing and a grazing management plan should reduce the impact of cattle grazing.

PROJECT COLLABORATORS

BCMELP, Adams Lake and Neskonlith Indian Bands, BCMAFF, local fish and game club and local naturalists

CLIENTS/AUDIENCE

Naturalists, city of Salmon Arm, BCMELP, Adams Lake and Neskonlith Indian Bands (see collaborator list)

OBJECTIVES

Fencing and grazing management plan to exclude cattle permanently or yearly from wetland sites. Improvement of nesting and breeding habitat.

BACKGROUND AND NEED

Foreshore is a provincially significant waterfowl migration stop. Intense grazing pressure in this area has resulted in reduced waterfowl breeding habitat.

METHODOLOGYIAPPROACH

Construction and maintenance of berms, loafing logs, floating nest islands and nest boxes for the life of the project. Fencing and water control structures.

ANTICIPATED OUTPUTS

Increased waterfowl habitat will increase this sites importance as a migratory stop and

breeding area. The project will demonstrate that cooperation between wildlife managers and cattle producers can be mutually beneficial. An area for waterfowl to graze is important to the Salmon Arm community because it will hopefully reduce the use by waterfowl on local parks and golf courses.

RESULTS TO DATE

Completed 1993

BUDGET

$55,000

PROJECT TYPE

Demonstration project

PROJECT TIME FRAME

Date initiated: 1994
Date completed: 1994

PROJECT LEADER ‘

Ian Barnett
District Manager
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Kamloops B.C. V2C 5P5

LOCATION /TYPE OF LITERATURE /DOCUMENTS

File located in office.

SUBJECT/ABSTRACT

Fallis lake is a highly productive wetland which is limited in its value to some wildlife by the amount of grazing on the marginal forages and upland cover. A demonstration project was set up to exclude cattle grazing by fencing and to provide an alternate watering facility. Development should improve waterfowl habitat.

PROJECT COLLABORATORS

Land owner
Ducks Unlimited (IWP)

CLIENTS/AUDIENCE

Livestock producers, land owner and resource managers

OBJECTIVES

Improve water fowl and wildlife habitat on Fallis Pond through the use of a demonstration project which limits grazing on its margin. Also improve quality of water available to livestock.

BACKGROUND AND NEED

Fallis lake is highly productive wetland limited by grazing on its margin and uplands. Demonstration projects such as this are needed to promote land-use practices that:

1. maintain and protect habitat for migratory birds and other wetland dependent wildlife,
2. protect water supplies and water quality, and
3. encourage sustainable agriculture.

METHODOLOGY/APPROACH

Construction of fencing and alternate watering facilities.

ANTICIPATED OUTPUTS

Increased plant and animal populations, improved water quality and benefits to the cooperating land owner.

RESULTS TO DATE

Project completed

BUDGET

$10,000

PROJECT TYPE

Demonstration Project

PROJECT TIME FRAME

Date initiated: 1993
Date completed: to be completed spring 1995

PROJECT LEADER

Ian Barnett
District Manager
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Kamloops B.C. V2C 5P5

LOCATION /TYPE OF LITERATURE /DOCUMENTS

File #2790 located in office.

SUBJECT/ABSTRACT

Cattle grazing management demonstration project on north side of South Thompson River. Fencing (3.4 km) and stock watering developments will be used to limit or eliminate cattle grazing riparian sites on river. This is a valuable demonstration project because of the number of cooperators and proximity to a large population base (Kamloops City).

PROJECT COLLABORATORS

Karnloops City, Ministry of Environment Public Conservation Assistance Fund, Harper Ranch, Department of Fisheries and Oceans (DFO), Ministry of Agriculture and Fisheries, Ducks Unlimited, Environment Canada: Fraser River Action Plan, Norkam School and Tree Plant Canada.

CLIENTS/AUDIENCE

Livestock producers, land owner and resource managers, public.

OBJECTIVES

To control cattle grazing on the margins of the South Thompson River and improve the habitats for waterfowl and wildlife, and improve water quality.

BACKGROUND AND NEED

The South Thompson River east of Kamloops is a highly productive watercourse affected by grazing on its margin and uplands. It is also the water supply for Kamloops city . Demonstration projects such as this are needed to promote land-use practices that: 1. maintain and protect habitat for migratory birds and other wetland dependent wildlife and fish, 2. protect water supplies and water quality, and 3. encourage sustainable agriculture.

METHODOLOGY/APPROACH

Construction of fencing and alternate watering facilities for the cattle.

ANTICIPATED OUTPUTS

Increased plant and animal populations, improved water quality and benefits to the cooperating land owners

RESULTS TO DATE

Project ongoing

BUDGET

$100,000

PROJECT TYPE

Demonstration project

PROJECT TIME FRAME

Date initiated: Negotiations initiated 1993 and ongoing.
Date completed:

PROJECT LEADER

Ed Hennan
Provincial Biologist
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Kamloops B.C. V2C 5P5

LOCATION /TYPE OF LITERATURE /DOCUMENTS

File located in office.

SUBJECT/ABSTRACT

Tunkwa and Leighton Lakes, built for storage of irrigation water in the 1930s have become a very popular recreation area. Area ranches recognize the importance of this recreational and wildlife resource and are cooperating to improve the supply and quality of water, and the supply of forage from the surrounding rangelands. This is to be achieved through a combination of water development and range management projects.

PROJECT COLLABORATORS

Grazing Licensees
Ministry of Agriculture Food and Fisheries
BCMELP
Ducks Unlimited Canada (IWP)
BCMF
Ainsworth Lumber
Dominic Lake Resort

CLIENTS/AUDIENCE

Livestock producers, resource managers and recreationists.

OBJECTIVES

Improve the condition of the grasslands with an improved grazing system with the use of fencing. Improve the waterfowl habitat, water quality and quantity for agriculture and fisheries with the cooperation of all resource users.

BACKGROUND AND NEED

Demonstration projects such as this are needed to promote land-use practices that: 1. maintain and protect habitat for migratory birds and other wetland dependent wildlife, 2. protect water supplies and water quality, and 3. encourage sustainable agriculture.

METHODOLOGY/APPROACH

Construction of fencing, alternate watering facilities and improved water management capability.

ANTICIPATED OUTPUTS

Improved rangeland, including: increased plant and animal populations ,improved water quality and management and improved forage production.

RESULTS TO DATE

Negotiations and planning ongoing.

BUDGET

unknown

PROJECT TYPE

Demonstration Project

PROJECT TIME FRAME

Date initiated: 1994
Date completed: 1994

PROJECT LEADER

Murray Clark
District Manager Prince George or
Doug Regier
Area Manager Williams Lake
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Karnloops B.C. V2C 5P5

LOCATION /TYPE OF LITERATURE /DOCUMENTS

File #265 1 located in office.

SUBJECT/ABSTRACT

Colpitt Lake had a condemned earthen dam at its outlet. The loss of this dam would significantly reduce the size and quality of the habitat it provides and its value for stock watering and irrigation water storage. Free-ranging cattle concentrate along the riparian area of Frost Creek and have degraded the habitat by over-grazing and trampling. The uplands immediately adjacent to Colpitt and Axe Lakes have been logged and this allows for increased cattle grazing. New water control structures, stabilized cattle crossings through riparian areas and fenced off upland and riparian areas will improve wildlife habitat and provide a cleaner and more reliable source of water for irrigation, livestock and wildlife.

PROJECT COLLABORATORS

Land owner
Ducks Unlimited (IWP),
Grazing permit holder
B.C. Forest Service.

CLIENTS/AUDIENCE

Livestock producers, land owner and resource managers

OBJECTIVES

Demonstrate the compatibility of ranching practices with wildlife habitat enhancement techniques. The Range Division of the Forest Service is also interested in demonstrating these techniques to the ranching industry.

BACKGROUND AND NEED

There are insecure water levels in Colpitt and Axe Lakes. Overgrazing of riparian areas

resulting in poor cover, limited cavity nest sites due to logging practices and a lack of insular nesting and loafing sites. Demonstration projects such as this are needed to promote land-use practices that: 1. maintain and protect habitat for migratory birds and other wetland dependent wildlife, 2. protect water supplies and water quality, and 3. encourage sustainable agriculture.

METHODOLOGY/APPROACH

Construction of fencing and alternate watering facilities for the cattle.

ANTICIPATED OUTPUTS

Increased plant and animal populations, improved water quality and supply benefiting wildlife and cooperating land owners

RESULTS TO DATE

Project completed

BUDGET

$66,000

PROJECT TYPE

Demonstration Project

PROJECT TIME FRAME

Date initiated: 1994
Date completed: 1994

PROJECT LEADER

Murray Clark
District Manager Prince George or
Doug Regier
Area Manager Williams Lake
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Kamloops B.C. V2C 5P5

LOCATION /TYPE OF LITERATURE /DOCUMENTS

File # 288-2797 located in office.

SUBJECT/ABSTRACT

All three basins within the Buckskin Complex are affected by logging, cattle grazing and irrigation draw downs. This demonstration project will improve the supply of water for irrigation and waterfowl and protect the shoreline vegetation from overgrazing while providing a secure and clean source of water for stock watering.

PROJECT COLLABORATORS

Ducks Unlimited Canada, Grazing permit holder, B.C. Forest Service

CLIENTS/AUDIENCE

Livestock producers, land owner and resource managers

OBJECTIVES

Demonstrate the compatibility of ranching practices with wildlife habitat enhancement techniques. The Range Division of the Forest Service is also interested in demonstrating these techniques to the ranching industry.

BACKGROUND AND NEED

There are insecure water levels in the Buckskin Complex, overgrazing of riparian areas resulting in poor cover, limited cavity nest sites due to logging practices and a lack of insular nesting and loafing sites.

Demonstration projects such as this are needed to promote land-use practices that: 1. maintain and protect habitat for migratory birds and other wetland dependent wildlife, 2. protect water supplies and water quality, and 3. encourage sustainable agriculture.

METHODOLOGY/APPROACH

Construction of fences, alternate watering facilities for the cattle, artificial nesting sites and

improved water control structures

ANTICIPATED OUTPUTS

Increased plant and animal populations, improved water quality and supply benefiting wildlife and cooperating land owner.

RESULTS TO DATE

Project ongoing

BUDGET

$96,000

PROJECT TYPE

Demonstration Project

PROJECT TIME FRAME

Date initiated: 1993
Date completed: 1995?

PROJECT LEADER

Ian Barnett
District Manager
Ducks Unlimited
ph (604) 374-8307 fax (604) 374-6287
954 A Laval Crescent
Kamloops B.C. V2C 5P5

LOCATION /TYPE OF LITERATURE /DOCUMENTS

File located in office.

SUBJECT/ABSTRACT

This project involves fish and wildlife habitat protection and enhancement, erosion protection, and grazing management along the reach of the Nicola River between Nicola Lake and Merrit.

PROJECT COLLABORATORS

Ducks Unlimited Canada (IWP), Chutter Ranch, Nicola Ranch, River Ranch, DFO, and BCMELP.

CLIENTS/AUDIENCE

Livestock producers, resource managers and public.

OBJECTIVES

1. Reduce stream bank degradation, river erosion, sedimentation.
2. Protect specific hay fields from flooding.
3. Maintain or increase forage available to livestock.
4. Protect large trees from being felled by beaver.
5. Promote mixed native vegetation in the riparian zone.
6. Maintain or enhance habitat diversity.
7. Improve water permanence in, and open water /emergent interspersion of, select oxbow ponds.
8. Maintain or improve ground nesting cover for waterfowl.
9. Provide additional waterfowl nesting sites.
10. Improve habitat for deer, upland birds, small mammals, songbirds, amphibians, and reptiles.
11. Improve fish habitat in the river and in floodplain habitats.

BACKGROUND AND NEED

Portions of the river are degraded and subject to erosion. Protection of the riparian zone

and management of land use int he valley bottom can serve to maintain and enhance stream stability and habitats for a variety of fish and wildlife. Demonstration projects such as this are needed to promote land-use practices that: 1. maintain and protect habitat for migratory birds and other wetland dependent wildlife, 2. protect water supplies and water quality, and 3. encourage sustainable agriculture.

METHODOLOGY/APPROACH

This project involves: deepening of oxbow ponds, small water controls on oxbow ponds, riparian livestock - exclusion fencing, fencing for cattle management, tree planting, stream stabilization, cattle watering facilities, dyking to prevent flooding of agricultural fields, and informational signage.

ANTICIPATED OUTPUTS

Increased plant, fish, and wildlife populations and diversity: improved water quality, improved forage production.

RESULTS TO DATE

Project ongoing, monitoring program being designed.

BUDGET

$200,000+

PROJECT TYPE

Monitoring study.

PROJECT TIME FRAME

Date initiated: 1995

Date completed: At least 5 years, funding permitting.

PROJECT LEADER

Ed Hennan
Provincial Biologist
Ducks Unlimited,
954 A Laval Crescent
Kamloops B.C. V2C 5P5
ph (604) 374-8307 fax (604) 374-6287

LOCATION /TYPE OF LITERATURE /DOCUMENTS

see project leader

SUBJECT/ABSTRACT

This study assesses the impact of a specified amount of grazing on the maintenance or recovery of the riparian zone of the Nicola River.

PROJECT COLLABORATORS

Interior Wetland Program, DFO and BCMAFF.

CLIENTS/AUDIENCE

Livestock producers and riparian habitat managers.

OBJECTIVES

To determine if controlled livestock grazing is compatible with the ecology of a recovering riparian zone.

BACKGROUND AND NEED

A landowner in the Nicola basin requested Ducks Unlimited to determine if controlled cattle grazing is compatible with the ecology of a recovering riparian zone.

METHODOLOGY/APPROACH

Being developed.

Study sites selected.

ANTICIPATED OUTPUTS

Progress and final reports.

RESULTS TO DATE

Aerial photography completed in 1994. Photo mosaics and vegetation maps prepared.

BUDGET

Not established yet.

APPENDIX 1

1.2 DEPT. OF FISHERIES AND OCEANS PROJECTS

PROJECT TYPE

Stream Restoration Project

PROJECT TIME FRAME

Date initiated: July 1994
Date completed: ongoing

PROJECT LEADER

Michael Crowe
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone: (604) 374-2329; fax (604) 372-9771

LOCATION /TYPE OF LITERATURE /DOCUMENTS

in office files

SUBJECT/ABSTRACT

Program to demonstrate stream restoration techniques on areas impacted by agricultural/forestry related development. Designed to develop community awareness and participation in stream restoration. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, BCMELP - Watershed Restoration Program (Forest Renewal BC), BCMF, Shuswap Nation Fisheries Commission, local landowners.

CLIENTS/AUDIENCE

Community of Louis Creek (Louis Creek Watershed Roundtable), participating landowners.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

See abstract. Important salmonoid bearing tributary to N. Thompson. Coho stock in poor shape. Severely degraded stream riparian habitat and water quality

METHODOLOGYIAPPROACH

Construct stream stabilization structures such as tree revetments. This is coordinated with a fencing program to control livestock, and a planting program to redevelop riparian vegetation.

ANTICIPATED OUTPUTS

Restored riparian vegetation has many beneficial effects on stream habitat, such as: modifying water temperature, providing bank stability, creating cover, and is an important source of stream nutrients.

RESULTS TO DATE

Constructed 150 m of tree revetment and 100 m of exclusion fencing,

BUDGET

$11,000 to date.

PREPARED BY

Michael Crowe
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone: (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1992
Date completed: ongoing

PROJECT LEADERS

Dorothy Argent - Salmon River Watershed Roundtable Chair
Salmon River Watershed Project
P.O. BOX 3308
Salmon Arm, B.C.
V1E 4S1
phone (604) 832-0153; fax (604) 833-4676

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO and SRWRC in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on areas impacted by agriculture and forestry related development. Designed to develop community awareness and participation in stream restoration. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, bank trampling and excessive water withdrawal during late summer; all with consequential impacts to fish habitat.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, BCMF, BCMAFF/CSERF/BC21 (Community, Salmonoid Enhancement and Restoration Fund), BCMAFF/SPP (Sustainable Practices Program), Tree Plan Canada, Shuswap Nation Fisheries Commission, BC Hydro, local landowners, Salmon River Watershed Roundtable.

CLIENTS/AUDIENCE

Community along the Salmon River, (Salmon River Watershed Roundtable), participating landowners, and local Native Bands.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Historically important salmonoid bearing tributary to Shuswap system. Coho, chinook and sockeye stocks in poor shape. Severely degraded stream riparian habitat and water quality and quantity. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

METHODOLOGY/APPROACH

Construct stream stabilization structures such as tree revetments and rip rap; coordinated with a fencing program to control livestock, and a planting program to redevelop riparian vegetation.

ANTICIPATED OUTPUTS

Restored riparian vegetation has many beneficial effects on stream habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients.

RESULTS TO DATE

Constructed 1075 m of tree revetment, 4225 m of exclusion fencing , 570 m of rip rap and planted 4005 plants on 16 participating land owners properties.

BUDGET

$105,000 to date.

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Off-channel habitat restoration project

PROJECT TIME FRAME

Date initiated: 1992
Date completed: 1994

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321 Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

In-office files.

SUBJECT/ABSTRACT

Due to the loss of natural off-channel habitat such as ox-bows and marshes as a result of development, especially agricultural field improvement, salmonoids have lost critical habitat necessary for periods of development, such as over wintering and freshet. This project was designed to recreate some of this off-mainstem channel habitat by constructing a spawning and rearing channel.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, BCMELP - Habitat Conservation Fund, local landowner.

CLIENTS/AUDIENCE

Participating landowners

OBJECTIVES

See abstract.

BACKGROUND AND NEED

See abstract. Coho, chinook and steelhead stocks in poor shape. Severely degraded instream, riparian and off-channel habitat and water quality.

METHODOLOGY/APPROACH

Construct a spawning and rearing channel by excavating into the water table. Groundwater flows into the channel then into the mainstem. This provides habitat, access for mainstem salmonoids and improved water quality.

ANTICIPATED OUTPUTS

Restored off-channel habitat necessary to permit salmonoids to pass critical juvenile life stages such as overwintering and freshet. Increased juvenile survival. Improved water quality in the channel and mainstem.

RESULTS TO DATE

Constructed 500 m of channel. Provided complex habitat features to provide cover and nutrient sources.

BUDGET

$50,000

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Off-channel habitat restoration project

PROJECT TIME FRAME

Date initiated: 1994
Date completed: ongoing

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

In-office files.

SUBJECT/ABSTRACT

Due to the loss of natural off-channel habitat such as ox-bows and marshes as a result of development, especially agricultural field improvement, salmonoids have lost critical habitat necessary for periods of development, such as over wintering and freshet. This project was designed to recreate some of this off-mainstem channel habitat by constructing a rearing channel.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowner. ,

CLIENTS/AUDIENCE

Participating landowner

OBJECTIVES

See abstract.

BACKGROUND AND NEED

See abstract. Coho, chinook, sockeye and rainbow stocks in poor shape. Severely degraded instrearn, riparian and off-channel habitat and water quality.

METHODOLOGYIAPPROACH

Construct a rearing channel by excavating into the water table. Groundwater flows into the channel then into the mainstem. This provides habitat, access for mainstem salmonoids and improved water quality.

ANTICIPATED OUTPUTS

Restored off-channel habitat necessary to permit salmonoids to pass critical juvenile life stages such as overwintering and freshet. Increased juvenile survival. Improved water quality in the channel and mainstem.

RESULTS TO DATE

Constructed a 350 m test channel. Initial indicators are positive. The channel will be expanded an additional 250 m. Complex habitat features to provide cover and nutrient sources will be provided.

BUDGET

$7,300 to date.

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Karnloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Off-channel habitat restoration project

PROJECT TIME FRAME

Date initiated: 1994
Date completed: Ongoing

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321 Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

In-office files.

SUBJECT/ABSTRACT

Due to the loss of natural off-channel habitat such as ox-bows and marshes as a result of development, especially agricultural field improvement, salmonoids have lost critical habitat necessary for periods of development, such as over wintering and freshet. This project was designed to recreate some of this off-mainstem channel habitat by constructing a spawning and rearing channel.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowner.

CLIENTS/AUDIENCE

Participating landowner

OBJECTIVES

See abstract.

BACKGROUND AND NEED

See abstract. Coho, chinook and steelhead stocks in poor shape. Severely degraded instream, riparian and off-channel habitat and water quality.

METHODOLOGY/APPROACH

Construct a spawning and rearing channel by excavating into the water table. Groundwater flow into the channel then into the mainstem. This provides habitat, access for mainstem salmonoids and improved water quality.

ANTICIPATED OUTPUTS

Restored off-channel habitat necessary to permit salmonoids to pass critical juvenile life stages such as overwintering and freshet. Increased juvenile survival. Improved water quality in the channel and mainstem.

RESULTS TO DATE

Constructed a 600 m preliminary test channel. Initial test indicate the channel is productive. The channel is to be enhanced both in terms of size and habitat.

BUDGET

$7,100 to date.

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1991
Date completed: ongoing

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on areas impacted by agriculture and forestry related development. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, bank trampling and excessive water withdrawal during late summer; all with consequential impacts to fish habitat.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, Tree Plan Canada, Shuswap Nation Fisheries Commission.

CLIENTS/AUDIENCE

Community along the Bonaparte River, participating landowners.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Salmonoid bearing tributary to the Thompson River. Coho, chinook, rainbow and steelhead stocks in the system. Degraded instream and riparian habitat and water quality and quantity. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

METHODOLOGY/APPROACH

Construct stream stabilization structures such as tree revetments and rip rap; coordinated with a fencing program to control livestock, and a planting program to redevelop riparian vegetation.

ANTICIPATED OUTPUTS

Restored riparian vegetation has many beneficial effects on stream habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients.

RESULTS TO DATE

Constructed 500 m of tree revetment, 1000 m of exclusion fencing and planted 1500 plants.

BUDGET

$55,000 to date.

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1991

Date completed: ongoing

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on areas impacted by agriculture and forestry related development. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, bank trampling, excessive water withdrawal during late summer and loss of off-channel habitat; all with consequential impacts to fish habitat.

PROJECT COLLABORATORS'

Dept. of Fisheries and Oceans, Shuswap Nation Fisheries Commission, local landowners.

CLIENTS/AUDIENCE

Community along the Deadman River, Skeetchestn Indian Band, participating landowners.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Salmonoid bearing tributary to the Thompson River. Coho, chinook, rainbow and steelhead stocks in the system. Degraded instrearn, off-channel and riparian habitat and water quality and quantity. Many of the stream impacts result from field improvement, loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

METHODOLOGY/APPROACH

Construct stream stabilization structures such as tree revetments and rip rap; coordinated with a fencing program to control livestock, and a planting program to redevelop riparian vegetation. Construct a rearing channel by excavating into the water table. Groundwater flows into the channel which flows the mainstem. This provides habitat and access to mainstem salmonoids and improved water quality.

ANTICIPATED OUTPUTS

Restored riparian vegetation has many beneficial effects on stream habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients.

RESULTS TO DATE

Constructed 2300 m of off-channel habitat, 520 m of tree revetment, O m of exclusion fencing, and planted 10,000 plants.

BUDGET

$137,000 total (not including the hatchery).

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1991
Date completed: ongoing

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on areas impacted by agriculture and forestry related development. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, bank trampling, excessive water withdrawal during late summer and loss of off-channel habitat; all with consequential impacts to fish.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowners

CLIENTS/AUDIENCE

Community along Dateau Creek, participating landowners.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

See Abstract. Salmonoid bearing tributary to the Shuswap system. Coho, chinook, and rainbow stocks in the system. Degraded instream, off-channel and riparian habitat and water quality and quantity.

METHODOLOGY/APPROACH

Construct stream stabilization structures such as tree revetments and rip rap; coordinated with a fencing program to control livestock, and a planting program to redevelop riparian vegetation. Construct a rearing channel by excavating into the water table. Groundwater flows into the channel then into the mainstem. This provides habitat and access to mainstem salmonoids, and improved water quality.

ANTICIPATED OUTPUTS

Increased juvenile survival. Improved water quality in the channel and mainstem. Restored riparian vegetation has many beneficial effects on instream habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients. Restored off-channel habitat necessary to permit salmonoids to pass critical juvenile life stages such as overwintering and freshet.

RESULTS TO DATE

Constructed a 500 m channel, 400 m^2 of pond habitat, 60 m of spiling, 7 km fencing, and planted 2500 plants.

BUDGET

$34,000 to date,

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1988

Date completed: ongoing

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on areas impacted by agriculture and forestry related development. Many of the stream impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, bank trampling, excessive water withdrawal during late summer and loss of off-channel habitat; all with consequential impacts to fish.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowners

CLIENTSIAUDIENCE

Community along Lemieux Creek, participating landowners.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Salmonoid bearing tributary to the North Thompson River. Coho, chinook, and rainbow stocks in the system. Degraded instream, off-channel and riparian habitat and water quality and quantity. Many of the stream impacts result from field improvement, loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

METHODOLOGY/APPROACH

Construct stream stabilizing tree revetments. Construct a rearing channel by excavating into the water table. Groundwater flow into the channel then into the mainstem. This provides habitat and access to mainstem salmonoids, as well as improved water quality.

ANTICIPATED OUTPUTS

Increased juvenile survival. Improved water quality in the channel and mainstem. Restored riparian vegetation has many beneficial effects on instream habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients. Restored off-channel habitat necessary to permit salmonoids to pass critical juvenile life stages such as overwintering and freshet.

RESULTS TO DATE

Constructed a 420 m channel and 165 m of tree revetment.

BUDGET

$31,000 to date.

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1992
Date completed: 1992

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on areas impacted by agricultural development. Many of the instream impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, and bank trampling, with consequential impacts to fish habitat.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowners

CLIENTS/AUDIENCE

Community along Shuswap River, participating landowners.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Salmonoid bearing tributary to the Shuswap System. Coho, chinook, and rainbow stocks. Degraded instrearn and riparian habitat. Many of the stream impacts result from field improvement, loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

METHODOLOGY/APPROACH

Construct stream stabilizing tree revetments.

ANTICIPATED OUTPUTS

Restored riparian vegetation has many beneficial effects on instrearn habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients.

RESULTS TO DATE

constructed a 245 m tree revetment.

BUDGET

$11,000

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1992
Date completed: 1992

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on an area impacted by agricultural development. Many of the stream's impacts result from loss of riparian vegetation, uncontrolled livestock access to the stream, and bank trampling, with consequential impacts to fish habitat.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowner.

CLIENTS/AUDIENCE

Community along Nicola River, participating landowner.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Salmonoid bearing tributary to the Thompson River. Coho, chinook, steelhead and rainbow stocks. Degraded instream and riparian habitat. Many of the stream impacts result from field improvement, loss of riparian vegetation, uncontrolled livestock access to stream and bank trampling.

METHODOLOGY/APPROACH

Construct stream stabilizing tree revetrnent.

ANTICIPATED OUTPUTS

Restored riparian vegetation has many beneficial effects on stream habitat, such as: modifying water temperature, providing bank stability, reducing stream siltation, creating cover, supplying large woody debris, and is an important source of stream nutrients.

RESULTS TO DATE

Constructed a 150 m tree revetment.

BUDGET

$7,000

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Restoration Program

PROJECT TIME FRAME

Date initiated: 1995
Date completed: 1995

PROJECT LEADER

Mel Sheng
Resource Restoration Biologist
Dept. of Fisheries and Oceans
Station 321- Suite 400-555 West Hastings St.
Vancouver, B.C. V6B 5G3
(604) 666-6578 fax (604) 666-0292

LOCATION /TYPE OF LITERATURE /DOCUMENTS

DFO in-office files

SUBJECT/ABSTRACT

Program to conduct stream restoration on an area impacted by agriculture and other development. Many of the stream's impacts result from loss of riparian vegetation, with consequential impacts to fish habitat.

PROJECT COLLABORATORS

Dept. of Fisheries and Oceans, local landowner.

CLIENTS/AUDIENCE

Participating landowner.

OBJECTIVES

See abstract.

BACKGROUND AND NEED

Salmonoid bearing tributary to the North Thompson River. Coho, chinook and rainbow stocks. Degraded instream and riparian habitat. Excessive lateral erosion.

METHODOLOGY/APPROACH

Conduct stream stabilization using rip rap.

ANTICIPATED OUTPUTS

Restored stream stability will reduce erosion and siltation in the stream.

RESULTS TO DATE

To be constructed in March, 1995.

BUDGET

$7,000

PREPARED BY

Michael Crowe - Restoration Project Coordinator
Habitat Biologist
Dept. of Fisheries and Oceans
1278 Dalhousie Drive
Kamloops B.C. V2C 6G3
phone (604) 374-2329; fax (604) 372-9771

PROJECT TYPE

Monitoring Program

PROJECT TIME FRAME

Date initiated: May 1994
Date completed: Ongoing

PROJECT LEADER

Jennifer Nener
Water Quality Coordinator
Department of Fisheries and Oceans
Suite 1220,555 W Hastings
Vancouver B.C. V6B 5G3
ph (604) 666-0395 fax (604) 666-0417

LOCATION /TYPE OF LITERATURE /DOCUMENTS

In house files

SUBJECT/ABSTRACT

Elevated water temperatures on the Nicola River have been a subject of concern to fisheries biologists for many years. High temperatures during the summer months likely result from a combination of the loss of riparian vegetation throughout the Nicola system, and from the warming which takes place in Nicola Lake (warm surface waters are discharged from the dam). This project was undertaken to determine whether or not the lake actually exerts a warming effect (ie. water flowing into the lake might already be very warm), and warming which occurs downstream from the lake. Data can be used to help assess a variety of remediation strategies. Unfortunately the data logger installed above Nicola Lake malfunctioned, so no data were obtained from this site.

PROJECT COLLABORATORS

B.C. Ministry of Environment, Lands and Parks

CLIENTS/AUDIENCE

D.F.O. Habitat Managers, Land Owners.

OBJECTIVES

To document water temperature problems on Nicola water system caused by agriculture, urbanization, and forestry; with the intent to develop a corrective action plan.

BACKGROUND AND NEED

The BC Ministry of Environment and the Department of Fisheries and Oceans are concerned that water temperatures in the Nicola River are too high for healthy fish habitat. They suspect that the Nicola Lake dam and land clearing for agriculture, forestry and urbanization have caused the historical rise in water temperature. The Nicola Lake dam prevents deeper colder water from escaping from the lake, and the effects of land clearing in the riparian zones reduces the cooling effects of vegetation on water temperature.

METHODOLOGY/APPROACH

Thermistors and data loggers are in place at six locations: 1 above the lake and 5 along the Nicola River. These monitor the water temperature continuously each summer from June to October. Some water quality sampling is also being done in cooperation with the BC Ministry of Environment.

ANTICIPATED OUTPUTS

Report and action plan, spring 1996.

RESULTS TO DATE

Draft report summer 1994.

BUDGET

NIA

PROJECT TYPE

Development of an educational guide.

PROJECT TIME FRAME

Date initiated: November 1994
Date completed: Ongoing (Scheduled for completion fall of 1995)

PROJECT LEADER

Jennifer Nener
Water Quality Coordinator
Department of Fisheries and Oceans
Suite 1220, 555 W Hastings
Vancouver B.C. V6B 5G3
ph (604) 666-0395 fax (604) 666-0417

LOCATION /TYPE OF LITERATURE /DOCUMENTS

Will be widely distributed to agricultural producers and hobby farmers.

SUBJECT/ABSTRACT

Farm management practices must be improved in B.C. in order to reduce impacts to water quality and fish habitat. Raising awareness of the issues among producers is critical to achieving the necessary improvements. The educational stewardship document is being produced to provide a tool for field staff and assist in educating landowners and producers about the impacts of poor practices on other resources.

PROJECT COLLABOR4TORS

B.C. Ministry of Environment, Lands and Parks
Environment Canada
Ministry of Agriculture, Food, and Fish
B.C. Federation of Agriculture

CLIENTS/AUDIENCE

Farm owners/operators

OBJECTIVES

To develop and distribute an educational guide which will teach the principles of stream stewardship to agricultural producers. The guide will explain the benefits of improved practices to both the producer/land owner, and the environment. It will also direct the reader to technical “how to” information.

BACKGROUND AND NEED

The impacts of agriculture on riparian areas, fish habitat, and water quality are widespread in British Columbia. In many cases, poor farming practices are also costly to the landowner by causing problems such as erosion. Without providing some education to landowners, this situation is unlikely to improve. The guide will be made widely available, along with the opportunity for training, to all types of producers.

METHODOLOGY/APPROACH

Representatives from a wide range of agencies and interest groups met to discuss common interests, and whether or not there was a need for a stewardship document as described above. All participants believed that such a document would serve as a valuable tool in reducing impacts from agriculture on the environment. A draft Table of Contents was developed and agreed upon by all participants. A contract was then let to develop the document, with input to be provided on an as-need basis by participating agencies/interest groups.

ANTICIPATED OUTPUTS

A full-colour guide.

RESULTS TO DATE

NIA

BUDGET

N/A

APPENDIX 1

1.3 BC MINISTRY OF HEALTH PROJECTS

PROJECT TYPE

Survey

PROJECT TIME FRAME

Date initiated: 1993
Date completed: ongoing

PROJECT LEADER

Ken Christian
Chief Environmental Health Officer
B.C. Ministry of Health and Ministry Responsible for Seniors
Environmental Health Protection Services
(604) 828-4411 fax (604) 828-4636
South Central Health Unit
519 Columbia St
Kamloops B.C. V2C 2T8

LOCATION /TYPE OF LITERATURE /DOCUMENTS

Data base on computer files and annual reports located in office.

SUBJECT/ABSTRACT

Domestic water quality from community water systems and raw water sources throughout the South Central Health Unit Region. Microbiological and chemical water quality data are collected from an area of Chase to Goldbridge and Blue River to Merritt.

PROJECT COLLABORATORS

B.C. Ministry of Health

CLIENTS/AUDIENCE

Public health community, municipal and regional governments, and water purveyors.

OBJECTIVES

Monitor domestic water quality.

BACKGROUND AND NEED

Prevention and monitoring of water quality for domestic consumption is need to avoid outbreaks of enteric disease.

METHODOLOGY/APPROACH

Number of samples per 1000 population and timing are set by Canadian Drinking Water Guidelines.

ANTICIPATED OUTPUTS

Monthly reports and a database of continuous water quality data.

RESULTS TO DATE

Project ongoing

BUDGET

$50,000/year

APPENDIX 1

1.4 BC MINISTRY OF THE ENVIRONMENT PROJECTS

PROJECTTYPE

Standards for water quality

PROJECT TIME FRAME

Date initiated: unknown
Date completed: ongoing

PROJECT LEADER

Water Quality Branch Environmental Protection Department
Ministry of Environment, Lands and Parks.

LOCATION /TYPE OF LITERATURE /DOCUMENTS

BC Ministry of Environment Lands and Parks, Kamloops.

SUBJECT/ABSTRACT

The Water Quality Branch, BC Environment, is developing province-wide water quality criteria for use in assessing water quality data and preparing site-specific water quality objectives. Water quality criteria area safe levels of a contaminants for the protection of a given water use.

PROJECT COLLABORATORS

BCMELP, unknown

CLIENTS/AUDIENCE

unknown

OBJECTIVES

To establish and improve water quality criteria to be used as a water quality data screening tool.

BACKGROUND AND NEED

See Abstract.

METHODOLOGY/APPROACH

The water quality criteria includes the physical, chemical and biological quality of the water, sediment and biota. They represent a quick appraisal of the major references for the most common water quality characteristics of concern in British Columbia. The working criteria are intended to be used as a water quality data screening tool. Many of the working criteria are those recommended by the Canadian Council of Ministers of the Environment (CCME) in the Canadian Water Quality Guidelines originally published in March, 1987.

ANTICIPATED OUTPUTS

A complete set of water quality criteria approved for setting water quality standards on a provincial basis.

RESULTS TO DATE

Approved and Working Criteria for Water Quality -1994

BUDGET

unknown

PROJECT TYPE

Standards for water quality.

PROJECT TIME FRAME

Date initiated: unknown
Date completed: ongoing

PROJECT LEADER

Water Quality Branch Environmental Protection Department
Ministry of Environment, Lands and Parks.

LOCATION /TYPE OF LITERATURE /DOCUMENTS

BC Ministry of Environment, Lands and Parks, Kamloops

SUBJECT/ABSTRACT

Water quality objectives are safe levels set by the ministry to protect the most sensitive water use. They establish a reference against which the state of water quality can be checked and are a basic tool for assessing the health of an aquatic environment.

PROJECT COLLABORATORS

BCMELP, unknown

CLIENTS/AUDIENCE

unknown

OBJECTIVES

To set water quality standards for managing the Bonaparte River.

BACKGROUND AND NEED

At times and places on the river faecal coliform, suspended solids, and chlorophyll-a objectives are exceeded. Sources of potential contaminations in the River basin include municipal sewage at Cache Creek and Clinton and diffuse discharges form agricultural operations. In the river and creek, most of the water quality problems are thought to be due to agricultural operations.

METHODOLOGY/APPROACH

A routine of water sampling and monitoring.

ANTICIPATED OUTPUTS

A set of water quality objects for the Bonaparte River Basin.

RESULTS TO DATE

A set of water quality objectives for the Bonaparte River Basin.

BUDGET

unknown

PROJECT TYPE

Standards for water quality.

PROJECT TIME FRAME

Date initiated: unknown
Date completed: unknown

PROJECT LEADER

Water Quality Branch Environmental Protection Department
Ministry of Environment, Lands and Parks.

LOCATION /TYPE OF LITERATURE /DOCUMENTS

BCMELP KAMLOOPS.

SUBJECT/ABSTRACT

Water quality objectives are safe levels set by the ministry to protect the most sensitive water use. They establish a reference against which the state of water quality can be checked and are a basic tool for assessing the health of an aquatic. environment.

PROJECT COLLABORATORS

BCMELP unknown

CLIENTS/AUDIENCE

unknown

OBJECTIVES

To set water quality standards for managing the Thompson River.

BACKGROUND AND NEED

In general, the water quality of the mainstream Thompson is relatively good although there have been , in some cases, significant impacts from municipal or industrial discharges as well as from non-point inputs.

METHODOLOGY/APPROACH

A routine of water sampling and monitoring.

ANTICIPATED OUTPUTS

Water uses have been identified and water quality objectives set for characteristics such as microbial indicators, colour, chlorinated organics and resin acids in various reaches of the Thompson to provide a basis for future water quality protection and management.

RESULTS TO DATE

A set of water quality objectives for the Thompson River.

BUDGET unknown

PROJECT TYPE

Standards for water quality.

Appendix 1.4 MOE 4: Water Quality Objectives - Williams Lake and the San Jose River 83

PROJECT TIME FRAME

Date initiated: unknown
Date completed: unknown

PROJECT LEADER

N. K. Nagpal, PhD
Water Quality Branch Environmental Protection Department
Ministry of Environment, Lands and Parks.

LOCATION /TYPE OF LITERATURE /DOCUMENTS

BC Ministry of Environment Land Parks, Kamloops.

SUBJECT/ABSTRACT

Water quality objectives are safe levels set by the ministry to protect the most sensitive water use. They establish a reference against which the state of water quality can be checked and are a basic tool for assessing the health of an aquatic environment.

PROJECT COLLABORATORS

BCMELP, unknown

CLIENTS/AUDIENCE

unknown

OBJECTIVES

To set water quality standards for managing Williams Lake and San Jose River

BACKGROUND AND NEED

unknown

METHODOLOGY/APPROACH

A routine of water sampling and monitoring.

ANTICIPATED OUTPUTS

unknown

RESULTS TO DATE

A set of water quality objectives for Williams Lake and the San Jose River.

BUDGET

unknown

PROJECT TYPE

Inventory of spring melt conditions.

PROJECT TIME FRAME

Date initiated: 1985
Date completed: ongoing

PROJECT LEADER

Ron Townson
Environmental Protection Officer
B.C. Ministry of Environment
3547 Skaha Lk Rd
Penticton B.C. V2A 7K2
(604) 490-8276 fax (604) 492-1314

LOCATION /TYPE OF LITERATURE /DOCUMENTS

see above address

SUBJECT/ABSTRACT

The Ministry of Environment, Lands and Parks conducts one helicopter flyover per year to identify agricultural sites where spring snow melt is carrying animal faecal material into adjacent water courses. This site is cataloged into a photographic inventory and the complaint is referred to the Agricultural Environmental Protection Council.

PROJECT COLLABORATORS

B.C. Ministry of Environment, Lands and Parks

CLIENTS/AUDIENCE

B.C. Ministry of Environment, Lands and Parks, livestock producers, Agriculture Environmental Practices Committee.

OBJECTIVES

To identify agricultural businesses that pollute water courses.

BACKGROUND AND NEED

In 1970's agriculture was identified as a source of phosphorous contamination in the Okanagan Basin. In 1985 the Okanagan was declared as environmentally sensitive. At this time helicopter flyovers were first used as a cost effective way of monitoring livestock pollution of the Okanagan/Shuswap area.

METHODOLOGY/APPROACH

One flyover per year is conducted to photograph and catalogue those agricultural operations who are contaminating water courses with faecal material during spring runoff. The area covered by these flights includes the Okanagan, Similkameen and the Shuswap drainage as far as the top half of Mara Lake. These operations are referred to the Agricultural Environmental Protection Council. Members of the council consult with the operator and make recommendations under the Agricultural Environment Protection Code

to correct the infraction.

ANTICIPATED OUTPUTS

Photographic inventory of agricultural polluters.

RESULTS TO DATE

Photographic inventory of agricultural polluters

BUDGET

$6-8000/year

PROJECT TYPE

Water quality study

PROJECT TIME FRAME

November 1990- August 1991

PROJECT LEADER

Sandy Hart

PROJECT COLLABORATORS

Environmental Protection Branch, MELP, Williams Lake.

CLIENTS/AUDIENCE

BCMELP

OBJECTIVES

To identify phosphorus sources which may impair water quality of Lac La Hache - Primary focus is evaluation of livestock wintering areas as phosphorus sources.

METHODOLOGY

Mapping of basic terrain conditions and muting with ranchers about livestock management practices including field inspections. Observation of snow melt runoff processes and some water quality sampling. Helicopter overview flight in March. Water tested for dissolved and total phosphorus.

ANTICIPATED OUTPUTS

Report - Phosphorus Sources in the Lac La Hache Drainage Basin, August 1991

RESULTS TO DATE

47 wintering areas inspected: 7 high to moderate impact, 29 low to moderate impact, 11 low impact

BUDGET

unknown

PROJECT TYPE

Water quality study

PROJECT TIME FRAME

December 1989- March 1990

PROJECT LEADER

Sandy Hart

PROJECT COLLABORATORS

Waste Management Branch , MELP, Williams Lake

CLIENTS/AUDIENCE

BCMELP

OBJECTIVES

1. To identify the distribution and intensity of use of livestock wintering grounds.
2. To describe the physical controls of phosphorus movement to channels during the snow melt period.
3. To provide a qualitative rating of the magnitude of phosphorus contributions from livestock wintering grounds to the channel system.
4. To consider whether agricultural land use practices have accelerated rates of surface erosion and channel back erosion. Therefore, increasing downstream phosphorus loading.
5. To recommend methods of reducing snow melt period phosphorus loading of San Jose River.

METHODOLOGY

Aerial photos interpreted for terrain, soils and vegetation and fluvial activity and some field checking. Meetings with Rancher to discuss management practises and terrain. Field inspections for livestock distribution, snow accumulation, frost penetration and slope gradient. Helicopter flights March 27- runoff processed stream channel forms. Water samples - dissolved phosphorus dissolved orthophosphate and total phosphorus.

ANTICIPATED OUTPUTS

Report - Phosphorus Sources in the San Jose River Basin: Effects of Winter Livestock Management Processes.

RESULTS TO DATE

62 sites described: 12 high or mod-high impact, 22 moderate to low-moderate impact, 28 low impact. Of 12 sites high impact 11 water sample sites. In all cases phosphorus increased downstream of the site as compared to upstream in runoff meltwater.

BUDGET

unknown

PROJECT TYPE

Survey

PROJECT LEADER

Barbara John
Regional Environmental Protection
BC Ministry of Environment Lands and Parks
1259 Dalhousie Drive
Kamloops, B.C. V2C 525
ph(604) 371-6200 fax(604) 828-4000

LOCATION/TYPE OF LITERATURE

BC Min Environment, Lands and Parks, Kamloops B.C.
contact: Barb John

SUBJECT/ABSTRACT

An annual survey and inventory of agricultural practices conducted using helicopter flyovers. The survey includes 103 sites of potential environmental impact from agriculture. The proximity of feeding areas and cattle access to watercourses are assessed. Sites are ranked and referred to the appropriate agency for evaluation.

PROJECT COLLABORATORS

B.C. Min of Environment Lands and Parks
Fraser Pollution Abatement Office

CLIENTS/AUDIENCE

Livestock producers and water resource managers.

OBJECTIVES

To develop an inventory of agricultural practices that pollute watercourses.

BACKGROUND AND NEED

The reduction in loading of nutrients and other contaminants from agricultural runoff can be achieved through the identification of sources and contaminants and the implementation of abatement and prevention measures.

METHODOLOGY/APPROACH

Annual flyovers are conducted during spring runoff to photograph and catalogue those agricultural operations who impact water courses or have potential to impact with faecal material during spring runoff. These operations are referred to the appropriate agency. Site specific recommendations are made to ensure compliance with the Agriculture Environment Protection Code. These operations are referred to the Agricultural Environmental Protection Council. Members of the council consult with the operator and make recommendations under the Agricultural Environment Protection Code to correct the infraction.

ANTICIPATED OUTPUTS

Photographic inventory of agricultural polluters and reduction in loading of nutrients and contaminants to the Thompson Basin.

RESULTS TO DATE

1994 report completed.

BUDGET

$20,000/year for 3 years.

PROJECT TYPE

Standards for water quality.

PROJECT TIME FRAME

Date initiated: unknown
Date completed: March 1991

PROJECT LEADER

L. G. Swain Water Quality Branch Environmental Protection Department
Ministry of Environment, Lands and Parks.

LOCATION /TYPE OF LITERATURE /DOCUMENTS

MELP Penticton.

SUBJECT/ABSTRACT

Water quality objectives are safe levels set by the ministry to protect the most sensitive water use. They establish a reference against which the state of water quality can be checked and are a basic tool for assessing the health of an aquatic environment.

PROJECT COLLABORATORS

BCMELP unknown

CLIENTS/AUDIENCE

unknown

OBJECTIVES

To set water quality standards for managing the Shuswap-Mabel Area, Bessette Creek.

BACKGROUND AND NEED

Unavailable at time of printing

METHODOLOGY/APPROACH

A routine of water sampling and monitoring.

ANTICIPATED OUTPUTS

Unavailable at time of printing.

RESULTS TO DATE

A set of water quality objectives for managing the Shuswap-Mabel Area.

BUDGET

unknown

APPENDIX 1

1.5 CITY OF KAMLOOPS PROJECTS

PROJECT TYPE

Study

PROJECT LEADER

M. E. Warren P.Eng.
Utilities Engineer, City of Kamloops
Public Services and Operations Branch Engineering Division
City Hall, 7 Victoria St West
Kamloops B.C. V2C 1A2
(604) 828-3467

LOCATION/TYPE OF LITERATURE

105 Seymour St
contact: M Warren
or N.W. Hydraulics

SUBJECT/ABSTRACT

Review of South Thompson Water Shed (Kamloops to Chase Creek and including Chase Creek) to pinpoint sources of contamination. Turbidity levels are targeted and recommendations to reduce or control levels will be made. The study maybe expanded to include site specific subjects, such as Stobart Creek.

PROJECT COLLABORATORS

Ken Rood
N.W. Hydraulics (604) 980-6011
Department of Fisheries and Oceans, Thompson Nicola Regional District, B.C. Ministry of Forests.

CLIENTS/AUDIENCE

Kamloops City

OBJECTIVES

Reduce turbidity levels in Kamloops City drinking water.

BACKGROUND AND NEED

Fraser River Management Plan focused attention on turbidity in city water.

METHODOLOGY/APPROACH

Hydraulic/Geologic overview, site reconnaissance and fly overs.

ANTICIPATED OUTPUTS

Identify sources of turbidity and recommend actions to ameliorate.

RESULTS TO DATE

Interim report due in March.

BUDGET

$35,000

Appendix 1.5 KLPS 2: South Thompson River Turbidity Monitoring Program Kamloops 94

PROJECT TYPE

Monitoring Program

PROJECT TIME FRAME

Date initiated: June 1994
Date completed: ongoing till August 1996

PROJECT LEADER

M. E. Warren P.Eng.
Utilities Engineer
City of Kamloops
Public Services and Operations Branch Engineering Division
City Hall, 7 Victoria St West
Kamloops B.C. V2C 1A2
(604) 828-3467

LOCATION /TYPE OF LITERATURE /DOCUMENTS

Index of publications in library, 105 Seymour St

SUBJECT/ABSTRACT

Weekly monitoring of South Thompson River and tributaries; Kamloops to Chase. There are 17 sampling points including several on Chase Creek. Water is sampled for turbidity levels from February to August each year.

PROJECT COLLABORATORS

City of Karnloops, Ministry of Environment Water Rights Branch.

CLIENTS/AUDIENCE

City of Kamloops

OBJECTIVES

To pinpoint sources of turbidity on South Thompson River, Kamloops to Chase and to provide input into the Watershed Management Study Kamloops 1994.

BACKGROUND AND NEED

Sediment in Karnloops drinking water is a major concern. High levels of turbidity causes increased demand for chlorine and an unpleasant taste and appearance.

METHODOLOGY/APPROACH

Seventeen sampling points are water sampled weekly for turbidity during the months of February to August each year.

ANTICIPATED OUTPUTS

Report and computer files containing a spreadsheet of all data.

RESULTS TO DATE

Data for 1994 completed

BUDGET

$20,000 over 3 years.

Appendix 1.5 KLPS 3: South Thompson River Quality Monitoring Program Kamloops 96

PROJECT TYPE

Monitoring Program

PROJECT TIME FRAME

Date initiated: 1986

Date completed: ongoing long-term

PROJECT LEADER

M. E. Warren P.Eng.
Utilities Engineer
City of Kamloops
Public Services and Operations Branch Engineering Division
City Hall, 7 Victoria St West
Kamloops B.C. V2C 1A2
(604) 828-3467

LOCATION /TYPE OF LITERATURE IDOCUMENTS

Index of publications in library, 105 Seymour St

SUBJECT/ABSTRACT

Biannual sampling at 12 points on the Thompson Rivers in the Kamloops area for 40 parameters of water quality.

PROJECT COLLABORATORS

City of Karnloops, Ministry of Environment Water Rights Branch.

CLIENTS/AUDIENCE

City of Kamloops

OBJECTIVES

To maintain a long-term water quality record of the Thompson Rivers in the Kamloops area.

BACKGROUND AND NEED

Sediment in Karnloops drinking water is a major concern. High levels of turbidity causes increased demand for chlorine and an unpleasant taste and appearance. Giardia is also a major concern and filtration is the only effective treatment.

METHODOLOGY/APPROACH

Twelve sampling points are water sampled for 40 parameters each year.

ANTICIPATED OUTPUTS

Report and computer files containing a spreadsheet of all data.

RESULTS TO DATE

Data for 1994 completed

BUDGET

$7000/year

APPENDIX 1

1.6 NORTH OKANAGAN SOIL CONSERVATION GROUP PROJECTS

LOCATION
North Okanagan

PROJECT TYPE
Soil conservation, cattle and water quality

PROJECT TIME FRAME
Date initiated: July 1991
Date completed: March 1994

PROJECT LEADER
Irene M. Bevandick

LOCATION /TYPE OF LITERATURE IDOCUMENTS
Final Report North Okanagan Soil Conservation, newsletters, workshops, demonstrations

SUBJECT/ABSTRACT
Objectives

1. Increase awareness amongst producers of proper manure management practices that relate to manure application to cropland,
2. Assess the effects of different rates of manure application upon yield, crop nutrients and the soil particle.
3. Assess the effects of different methods of manure application upon yield, crop nutrients and the soil profile.
4. Increase the awareness amongst producers of the effects of cattle upon the quality of the soil and surface water.
5. Assess the effects of surface runoff from cattle feeding areas upon the quality of adjacent watercourses.
6. Assess' the effects of cattle access to watercourses for drinking purposes.
7. Assess the effects of cattle upon the soil quality in or adjacent to feeding areas.

PROJECT COLLABORATORS
Funding - Environmental Sustainability Initiative Program and
the Canada-British Columbia Soil Conservation Program

CLIENTS/AUDIENCE
Producers, government and industry

RESULTS TO DATE

Literature

-NOSCG newsletters December 1991, Spring, Summer, and Fall 1992, summer and fall 1993 and winter 1994.
-Water Quality Workshop Proceedings.
-The Farmer and the Environment Workshop Proceedings.
-Manure Injection (L. Bevandick)-literature review.
-NOSCG Technical Report on 1992-93 Demonstration Plots.
-NOSCG Technical Report on 1991-94 Soil and Water Quality Monitoring Program.
-Enviro Facts No. 1: How Clean is My Farm.
-Enviro Facts No. 2: The Manure Resource I.
-Enviro Facts No. 3: The Manure Resource I.
-Enviro Facts No. 4: Soil and Water Quality - The Impacts from Cattle.
-NOSCG Final Report.

Results

-Nitrate leaching at feedlot sites but not 30 m past site
-P levels decline in depth
-Leaching from unlined earthen runoff collection pits
-Organic matter declined from O-45 cm
-N fertilizer levels inconclusive for spring versus fall

Seasonal Feeding Sites

-Nitrate-N and organic matter decreased from O-45 cm
-Spring versus fall nitrate-N not a lot of variation
-P levels higher or same in Spring than Fall

Collection pit

-lateral leaching, nitrate and phosphorus high
-Unable to estimate downward leaching due to soil composition

Water Samples

-Organics settling beyond impact sites
-Runoff is main source of contamination during events and second source is from direct access by cattle
-Contamination with N, P, and faecal coliform noted with unlimited access and runoff
-Extent due to topographical features, water course flow and volume of runoff rather than cattle density
-Runoff effects limited to occasions where runoff is observed

BUDGET

unknown

APPENDIX 1

1.7 BC FEDERATION OF AGRICULTURE PROJECTS

LOCATION
Cache Creek

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Relocation of cattle facilities to prevent livestock from entering Bonaparte River.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Quesnel

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Drainage ditches and fencing to divert runoff (last year), install heated water trough (this year). Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENT/AUDIENCE
Land Owner

RESULTS TO DATE
NIA

BUDGET
N/A

LOCATION
Tatla Lake

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Construction of berm to prevent wastes from entering creek. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Quesnel

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIMEFRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
Ardcorp Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B C V8W 1E4
ph (604) 383-7924 fx (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Concrete pad between the barn and silo, ditching to improve drainage, intercept rain/snow melt from reaching pad. Dairy operation.

PROJECT COLLABORATORS
B C Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Cache Creek

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Relocate cattle handling and feeding area away from lake. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Monte Creek

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Containment of dairy barn effluent in a liquid manure system tank, containment of solid manure waste, diversion of run off. Dairy operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Chase

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Containment and redirection of waste runoff by changing levels and contour of cattle holding area and provision of new watering facilities. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Savona

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Control erosion from river. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
NIA

BUDGET
N/A

LOCATION
Savona

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Relocate feed lot away form creek by constructing new corrals and installing electric water trough. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENT/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Kamloops

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Cattle are to be fenced out of river and creek by the applicant, this project will assist in the provision of a waterline and troughs. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Kamloops

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
` Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Cattle are to be fenced out of river and creek by the applicant, this project will assist in the provision of a waterline and troughs. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Monte Creek

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
,ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Construct and drill a water well. Dairy operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Enderby

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Transfer parlour waste disposal from septic system to manure pit, collect, transfer runoff from barn and driveway away from stock area, manure pit conversion. Dairy operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Falkland

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Control erosion by rip rap, tree revetment, tree planting and livestock exclusion fencing. Sheep operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Enderby

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Fence off both sides of creek, develop watering hole as per code of practice for seasonal feeding area. Dairy operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

LOCATION
Salmon Arm

PROJECT TYPE
Agricultural Environmental Assistance Program

PROJECT TIME FRAME
Date initiated: 1994
Date completed: N/A

PROJECT LEADER
Bill Twaites
ARDCORP Program Manager
BC Agricultural Research and Development Corporation
846 Broughton Street
Victoria B.C. V8W 1E4
ph (604) 383-7924 fax (604) 383-5031

LOCATION /TYPE OF LITERATURE /DOCUMENTS
Data Base

SUBJECT/ABSTRACT
Provide power for existing wells on bench land so cattle may overwinter away from river. Cattle operation.

PROJECT COLLABORATORS
B.C. Green Plan, Agriculture and Agri-Food Canada, BCMAFF.

CLIENTS/AUDIENCE
Land Owner

RESULTS TO DATE
N/A

BUDGET
N/A

PROJECT TYPE

Peer producer council

PROJECT TIME FRAME

Initiated: 1990
ongoing:

PROJECT LEADER

B.C. Federation of Agriculture
846 Broughton St
Victoria BC V8W1E4
(604) 383-7171

LOCATION/TYPE OF LITERATURE

Environmental Guidelines for Beef Cattle Producers in BC.

SUBJECT/ABSTRACT

The Agriculture Environmental Protection Council (AEPC) resolves nuisance and pollution complaints against farms and ranches in BC. Peer producers investigate these complaints and attempt resolution without the use of regulatory or legal measures.

PROJECT COLLABORATORS

BC Federation of Agriculture, Ministry of Agriculture Fisheries and Food, Ministry of Environment lands and Parks.

CLIENTS/AUDIENCE

BC Agricultural Producers.

OBJECTIVES

To resolves nuisance and pollution complaints against farms and ranches in BC.

BACKGROUND AND NEED

The adoption of environmentally sustainable production practices is the aim of the BC Federation of Agriculture. The adoption of these practices at the farm level requires the education and cooperation of individual producers. In 1990, the BCFA formed the AEPC to use peer producers to find a solution to an individual producer's environmental problem.

METHODOLOGYIAPPROACH

Local peer inspector/advisors respond to pollution complaints against agriculture producers. Within two weeks of receipt of the complaint the peer will investigate the complaint and write a report which explains what the environmental concern is and if it is justified. Corrective action is recommended and a date is set for completion of these measures. This report is sent to the affected farm. Follow-up visits determine if there is compliance. In cases of non-compliance, government agencies concerned with pollution will be called into prosecute using laws or regulations contravened by the offending farming operation.

ANTICIPATED OUTPUTS

The adoption of environmentally sustainable production practices by BC agriculture producers on a voluntary basis through education and instruction from the AEPC.

RESULTS TO DATE

Ongoing

BUDGET

unknown

PROJECT TYPE

Extension/Technical Support

PROJECT TIME FRAME

ongoing

PROJECT LEADER

B.C. Ministry of Agriculture Food and Fisheries
Karnloops, Williams Lake and Salmon Arm

LOCATION/TYPE OF LITERATURE

1993/94 and 1994/95 Annual Reports BCMAFF Kamloops Regional Engineering Technologist.

SUBJECT/ABSTRACT

These provincial offices provide technical guidance and support to minimise agricultures' impact on water quality

PROJECT COLLABORATORS

BC Federation of Agriculture, BC Cattlemen's Association, Agriculture Canada

CLIENTS/AUDIENCE

BC Agricultural Producers.

OBJECTIVES

To provide support and guidance to the agriculture industry in dealing with waste management problems.

BACKGROUND AND NEED

BC Agriculture in a proactive effort to be environmentally sustainable and responsible needs the technical and financial support of BCMAFF.

METHODOLOGY/APPROACH

Extension

-Presentations- "Environmental Concerns for Beef Producers" to producers in Williams Lake and Quesnel .

-Publications -draft Fact sheet "Doing Your Own Environmental Assessment of Your Beef Operation"

- Two articles for " Beef in BC" from fact sheets; "Improved Livestock Access to Water using Geogrids" and "Innovative Livestock Watering Options" and arranged demonstration of 'Sling Pump';

Inter-agency

- BCMELP Environmental Protection staff regarding complaints and code concerns from flyovers

-farm calls with them to resolve producer problems

-help coordinate follow up to 'fly-over'

-maintain contact with them on problem sites
-Ducks Unlimited staff regarding habitat Improvement/livestock watering.
-Assisted formation of Tunkwa/Durand Water Users Group.
-Attended Louis Creek Watershed Round Table meeting.
-Met with FRAP and Agencies re 'Agriculture. Assessment' proposal.
-Met with BCMELP and BCCA re 1995 'protocol' on 'fly-overs'.
-Ducks Unlimited staff re Habitat Improvement/Livestock Watering project at Harper Ranch, Kamloops (DU and SPP).
-Met with BCCA re Beef Environmental Guidelines re Current Issues.
-Assisted AEPC/BCCA advisors with environmental complaints.

Policy Development

-Resource Issues - work on Agriculture committee on recommending guidelines for Community Watersheds relating to livestock grazing.
-Input to Water Act revision.
- BCMELP "Stewardship of the Water" workshop, Kamloops.

Technological Development and Engineering Services

-Farm engineering advisory service to such items as; water licensing, irrigation supply, and design, fertigation, flow measurement, creek bank protection, meadow drainage, survey for drainage and water storage, livestock water development assessment of on farm concerns of manure management water contamination, and siting of confined and seasonal feeding areas. Best Available Waste Management Plans were written for farms where required.

Financial Programs

-Farm calls and ARDCORP communication re "Sustainable Practices Program" projects.

ANTICIPATED OUTPUTS

The adoption of environmentally sustainable production practices by all BC agriculture producers.

RESULTS TO DATE

Ongoing

BUDGET

unknown

PROJECT TYPE

Industry in-house projects.

PROJECT TIME FRAME

ongoing

PROJECT LEADER

B.C. Agriculture Industry

LOCATION/TYPE OF LITERATURE

Contacts with BCMAFF

SUBJECT/ABSTRACT

These projects are poorly documented and no estimate of dollar value is available. They consist of individual proprietors completing projects which improve the environmental quality of their agricultural operations. They are privately funded (ie. non- government dollars). Technical assistance may be acquired from government offices, but the projects are managed and completed without direct government involvement. Estimates of the extent of this activity might be acquired from records of contacts with government offices for technical advice. The dollar value is considered to be substantial.

PROJECT COLLABORATORS

none

CLIENTS/AUDIENCE

BC Agricultural Producers.

OBJECTIVES

To improve the environmental and economic sustainability of individual agricultural producers.

BACKGROUND AND NEED

BC Agriculture makes a proactive effort to be environmentally sustainable and responsible without the coaxing or threat of government agencies, initiatives or legislation.

METHODOLOGYIAPPROACH

Individually determined.

ANTICIPATED OUTPUTS

The adoption of environmentally sustainable production practices by BC agriculture producers without the need for government funding.

RESULTS TO DATE

“Environmental Stewardship Award”, presented annually by BCCA.

BUDGET

unknown

APPENDIX 2

ENVIRONMENTAL GUIDELINES FOR BEEF CATTLE PRODUCERS IN BC

Chapter 9, “Land application of manure”

(BCMAFF 1992)

9 LAND APPLICATION OF MANURE

Animal manure is a valuable source of plant nutrients and organic matter. Manure contains a vast array of organisms that add to the biological activity in soils. If not managed with sufficient care, manure can be a major source of pollution. Poorly managed manure will contribute to contamination of surface and/or groundwater. Maximizing the fertilizer value of manure also minimizes the environmental impacts.

This section provides information on: composition and benefits of manure, factors affecting water contamination from manure, practical guidance on land application, manure application rates and manure spreading equipment.

9.1 COMPOSITION AND BENEFITS OF MANURE

Manure management systems consist of various components including manure collection, storage, transport and land application. Manure is a dynamic organic material continually undergoing biological and chemical changes. Each phase of management may result in losses and changes to the beneficial nutrients in the manure. Therefore, the values of manure as a fertilizer depends on the quantity and form of nutrients present when it is applied to land.

Table 9.1 shows the average amount of nutrients found in typical beef cattle manure. This table can be used by crop producers who are using beef cattle manure as an organic fertilizer. They can determine how much of manure is needed to give a desired application of nutrients.

VALUE OF NITROGEN (N) IN MANURE

Nitrogen in manure exists in two forms, inorganic and organic. Inorganic nitrogen (ammonia) is the simple, soluble form that plants can use. After application to land, ammonia is converted by soil bacteria to a nitrate (NO_3) form. Nitrate can be lost from the root zone through leaching or denitrification (loss to the atmosphere). Manure solids also contain nitrogen in the organic form. Until the organic matter is biologically decomposed in the soil, the nitrogen remains unavailable for plant use. Nitrogen in the organic form is desirable since it acts as a reserve in the soil and is slowly released for plant use.

Stored Manure. Solid beef cattle manure loses much of the ammonia in it to the atmosphere (volatilization) while in storage. When the material is eventually spread onto land for crop production, most of the remaining nitrogen is in the organic

TABLE 9.1
Typical Nutrient Contents Of Stored Beef Cattle Manure [a]

Management Type	Moisture Content percent[b]	Nitrogen Total kg/tonne	Nitrogen Ammonia kg/tonne	Phosphate Total kg/tonne	Potash Total kg/tonne
Outdoor feedlot	67.8	4.2	0.2	4.8	8.2

To convert to Imperial units 1 kg/tonne = 2.0 lbs/ton

[a] Data collected by North Okanagan Soil Conservation Group on North Okanagan beef cattle feedlots in 1991/92

[b] If moisture content of manure is different then the value shown nutrient content per tonne will also change.

form and not subject to volatilization. Because of the lack of inorganic forms, the nitrogen compounds in beef manure must be decomposed by soil microbes before they are available to plants. It can be assumed, as a general rule, that 50% of the nitrogen in the manure when applied, is available during the year of application. The rest of the nitrogen becomes available over the next three to five years.

If manure is applied during the fall or winter, it is estimated that up to one third of the nitrogen may be lost. The losses are due to leaching, denitrification and by runoff.

Grazing. Grazing animals deposit manure directly on the land in the form of urine and faeces. The nitrogen content of this manure depends on: size of animal, nitrogen content of the diet and consumption of water. The most significant factor governing the nitrogen content of the manure (especially the amount in urine) is the crude protein nitrogen content of the forage and other feed sources.

VALUE OF PHOSPHORUS (P) IN MANURE

Research indicates that 50% of total applied phosphorus in manure is available to the crop in the year it is applied. Most of the phosphorus contained in manure is in the organic form. Its availability is dependent on the rate at which soil organisms break down the organic material (mineralization) and release phosphorus.

On land where beef cattle manure has been applied regularly over many years, the phosphorus 'fixing' capacity of the soil is reduced. On such soil, the availability of the phosphorus in manure approaches 100%. Producers should assume manure to be as effective as chemical fertilizer in supplying phosphorus to crops.

VALUE OF POTASSIUM (K) IN MANURE

All potassium in manure is available to the current crop. Soil that regularly receives manure is not often lacking in this nutrient. Grass Tetany can be caused by cattle eating grass grown on soil with excess potassium.

TRACE ELEMENT VALUE

The major fertilizer nutrients of manure are considered to be nitrogen, phosphorus and potassium. However, manure also contains the secondary nutrients sulphur, magnesium and calcium, as well as the micronutrients iron, manganese, boron, chlorine, zinc, copper and molybdenum. The availability of these elements as plant nutrients, varies depending upon the soil type and soil acidity.

VALUE OF MANURE AS A SOIL CONDITIONER

A positive benefit of applying manure to soil is the improvement of the soil physical structure. The decomposition of manure by bacteria contributes to improved aeration, improved permeability, and increased water holding capacity of the soil. Other soil conditioning benefits include pH buffering and an improvement to soils having high salt levels. When using manure as a soil conditioner, application rates must not exceed the nutrient requirements of the crop grown.

9.2 FACTORS AFFECTING WATER CONTAMINATION

SOUTH COASTAL REGION

Soil Characteristics. The proportions of sand, silt, clay and organic matter in a soil determine the water and nutrient holding capacity. In general, soils with a high clay and/or organic matter content have a relatively high capacity to hold water and nutrients in the root zone. Sandy soils, on the other hand, have a low capacity. Therefore, the leaching of nutrients from sandy soils during the winter months is much greater than from more heavy textured soils or soils with a high level of organic matter.Leaching of nutrients from sandy soils could result in groundwater quality degradation.

Drainage. Poorly drained soils become saturated during late fall, winter and early spring. After saturation, precipitation can no longer enter the soil. Therefore, water accumulates on the soil surface and

eventually runs off into adjacent ditches or otherwatercourses. When this happens, materials, such as manure, that have been applied to the soil surface are removed with the water, and degrade receiving waters.

Slope. If water does not infiltrate soil on sloping lands it must run off. If these lands become saturated, runoff is even greater. Material such as manure and nutrient rich soil particles can be eroded and removed with the runoff water. This could contaminate receiving waters, or pond and contaminate ground water.

Nitrate in the Root Zone. The nitrate form of nitrogen is of major concern due to its potential to contaminate drinking water. Nitrate is also the dominant form of plant available nitrogen found in agricultural soils. Most of the nitrate in the root zone in the fall of the year is leached from the soil over the winter months. Where nitrate leaches from soils over sensitive groundwaters or adjacent to surface waters, the nitrate will contribute to water contamination.

Excessive levels of root zone nitrate are found in soils where the spring application rates of manure and fertilizer have been high in relation to the ability of the crop to use the nitrogen. Excessive levels of root zone nitrate are also found in soil where there has been a fall application of manure after the crop is harvested.

Lack of Cover Crops. Permanent grasslands and, to a lesser extent, fall planted cover crops take up soil nitrates (and other nutrients) during fall, winter and early spring. In addition, cover crops keep the soil surface open thereby reducing or eliminating ponding and surface runoff. Bare soil, on the other hand, is susceptible to leaching, surface sealing, ponding and runoff.

INTERIOR REGIONS

Spring Runoff. In the areas of the province where soils are frozen and snow accumulates during the winter months, smowmelt water can runoff the land into adjacent streams or bodies of water. Any manure that has been applied to the land since the previous fall can leave the land with the melt water and contribute to water contamination.

9.3 MONTHLY ENVIRONMENTAL CONSIDERATIONS

JANUARY, FEBRUARY AND MARCH

South Coastal Region. If the land is subject to flooding and/or runoff, no manure should be applied because of the high risk of contamination of adjacent waters. If, however, flooding and runoff is controlled through adequate on farm and regional drainage systems, some manure can safely be applied on grassland or land seeded to an overwintering cover crop. Manure should not be applied to bare land, or to frozen land or land covered with snow where there is a risk of runoff.

Interior Regions. In most cases, manure application cannot be contemplated due to frozen soil and snow cover. If field access is possible, manure application should only be considered if there is minimal chance of runoff during the spring breakup period (see Section 4.2, Seasonal Feeding Area Evaluation for risk assessment).

APRIL AND MAY

All Regions. On seasonal feeding areas collect and spread any build up of manure. On confined livestock areas remove and spread all manure.

On annually cropped land, apply and immediately incorporate the correct amount of manure. On grass land, apply the correct amount of manure. The correct amount of manure will supply the amount of nitrogen the crop removes, as calculated in Section 9.5, Manure Application Rates. Do not attempt to completely fertilize the crop with manure. Excess manure will result in a high rate of nitrate production in the latter part of the growing season and after harvest when nutrient uptake is minimal. Supplement the manure with fertilizer at planting or side dress time.

JUNE, JULY AND AUGUST

All Regions. If manure must be applied, in most cases it can be applied only to grassland due to the presence of actively growing crops on other hinds. Manure nitrogen efficiency for grassland can be greatly increased by irrigation immediately followin g application. Nitrogen efficiency can also be increased by application of very wet manure slurries (more than 95% moisture content). Application of additional fertilizer nitrogen to grassland should be fine tuned according" to the protein content of the forage. Grasses with a protein level of 20% or more have a high probability of nitrate accumulation in the grass. High nitrate grass can be harmful to cattle.

Although manure cannot be applied to annual crops during this period, crops can be supplemented with fertilizer nitrogen. A late spring soil test has been found to be useful in indicating whether a response to added nitrogen is to be expected. The critical range is 20 to 30 kg/ha (18 to 27 lb/at) nitrate nitrogen in the plough layer (O to 20 cm or O to 8 in). Soil nitrate nitrogen below this range is usually deficient in nitrogen. Soils deficient in nitrogen require supplementation before the crop will achieve sufficient yield. Soil above this range will generally supply all the crops' nitrogen requirements.

SEPTEMBER AND OCTOBER

South Coastal Region. This is the most critical time of the year if manure is to be managed in an environmentally sound manner. On annually cropped land, crops have reached maturity and nutrient uptake has ceased. Soil temperature and moisture conditions are near optimalifor formation of nitrates in the soil. Therefore any added manure will only further contribute to the problem of fall nitrate levels and overwinter leaching.

If manure must be applied during this period, it should be restricted to grasslands that are well drained and not subject to flooding or runoff. Grasses are still actively growing and their roots will capture much of the nitrate and prevent leaching. Even so only 40% of the annual allowable application should be spread in the fall and winter periods.

On other lands, winter cover crops must be planted before any application should be contemplated. Only spread manure to cover crops that are well established prior to September 15. These crops can act as 'catch crops' to catch the nitrate in the root zone and reduce leaching. Rates of application on these lands should be lower than on grasslands due to the more immature root system.

Interior Regions. Because of frozen soils and low winter precipitation, winter losses of nitrate due to minimal. Therefore, a high percentage of any nitrate left in the root zone following ha rves t will be retained for subsequent crops. A fall or spring soil test will assist producers to take advantage of nitrogen from manure and reduce the need for fertilizer nitrogen.

NOVEMBER AND DECEMBER

South Coastal Region. With the onset of winter, soil coo ls to the point where there is very little formation of nitrate in the root zone. However, many soils are now too wet to allow ready access for spreading without causing severe soil compaction. If, however, the soil is sufficiently dry to support traffic and floodiig and runoff never occurs due to adequate on farm and regional drainage systems, some manure can safely be applied on grassland or land seeded to an overwintering cover crop. Manure sh ould not be applied to bare land. No more than 40% of the annual allowable application should be spread between the September to December periods.

Interior Regions. **See January,** February and March.

9.4 ENVIRONMENTALLY SOUND MANURE MANAGEMENT

The following must be taken into consideration if manure is to be managed in an environmentally sound manner.

LONG TERM MANURE STORAGE

Maximum benefit is derived from manure when it is spread on the land in spring or summer. At this

time leaching and runoff risks are low and crop growth and nutrient uptake is high. Adequate .ge makes this possible by allowing more flexibility in choosing the correct time to apply the manure. See Section 8, Manure Storage.

ADEQUATE LAND BASE

To adhere to the recommended application rates, sufficient land must be available for the safe use of the amount of manure produced each year (see section 9.5, Manure Application Rates).

INCORPORATION OF MANURE

Incorporation either by injection, plough down, other tillage methods or irrigation should be practised to maximize nutrient recovery (by minimizing ammonia losses), reduce the likelihood of manure runoff and reduce odours.

PREVENT WATER CONTAMINATION

To prevent water contamination beef cattle manure should not be spread:

- within 5 m (17 ft) of a bank or a slope leading to any watercourse;
- within 30 m (100 ft) of streams flowing into shellfish growing areas or any well or spring used as a domestic water supply. These distances should be increased where the ground slopes toward the stream, watercourse or well;
- on steep slopes where erosion an/or surface runoff is likel y to occur;
- on saturated soils, where manure will not infiltrate into the soil;
- within the high water mark of field depressions during times of the year when there is a high risk of direct surface runoff to a watercourse
- in excess winds where drift can occur;
- on frozen or snow covered ground where runoff of snowmelt to open watercourses might occur; and
- on areas having standing water.

ODOUR CONTROL

Land applications of manure from intensive livestock production facilities frequently lead to complaints. Consideration of neighbors with respect to time of day and weather conditions when spreading manure can do much to avoid conflict. Longer storage periods to reduce the frequency of spreading, as well as immediate incorporation of the manure into the soil to minimize odour is encouraged.

The following spreading techniques should be considered to reduce odour nuisance problems.

- Apply manure early in the day when air is warming and rising and diluting odours, rather than later in the day when air is settling, cooling and concentrating odours.
- Try to spread on a cool day when odour production is lower.
- Try to spread all the manure in as short a time as possible.
- Whenever possible, avoid spreading manure on the weekends or holidays particularly on sites with neighbors near by.
- Use rapid cover techniques such as disking, pioughiig down or soil injection.
- Spread on days when wind will not carry odours or manure particles into public places, roads or neighboring lands.

9.5 MANURE APPLICATION RATES

Management is the key to using manure to promote crop production and soil improvement while minimizing any hazard to the environment. **Management means application" of manure at rates and times of year that**

- are compatible with the nutrient requirements and growing characteristics of the crop;
- take into account soil characteristics, drainage and the slope of the land; and
- recognize the need to protect the quality of surface and groundwater.

The amount of beef cattle manure applied each year should be governed by the amount of nitrogen removed in the harvested portion of the crop. If the amount of nitrogen applied in manure exceeds crop

needs, then, over time, nitrogen losses to the environment will be excessive. There are a number of factors that influence suggested application rates. Factors include: the amount of nitrogen in the soil, amount of manure added in previous years, the length of time manure is left on the soil surface before incorporation, amount of crop refuse left in the field, and presence or absence of a winter cover crop. For more detailed information see Appendix E, Beef Cattle Manure Land Application.Manure application rates are based on nitrogen. It is not a requirement to balance the other nutrients in manure to the crop utilization. This means that excess phosphorus will usually be applied to the soil. If the phosphorus does not runoff the soil, pollution is not likely to occur.

Manure Application Rates To Grassland. Well managed, productive grass swards that have a high requirement for nitrogen and extensive root systems are very efficient in taking nitrogen compounds from the soil profile. Therefore, leaching losses are generally low under productive grass swards. The low leaching losses of productive grass stands allows this crop to receive a higher manure nitrogen application rate per unit of nitrogen removed by the harvested portion of the crop compared to other crops.

Some fall and winter applications of manure can be considered if the following conditions are met:

- the land is not subject to flooding or runoff;
- the grass sward is managed for high yields and all vegetative growth is removed from the field during the growing season;
- the grass sward is not used for grazing; and
- application of manure does not harm the sward by causing smothering and scorching.

Land Area Suggested for Manure Spreading. Any operation spreading manure on less land than required should request a "Best Agricultural Waste Management Plan" (explained in Appendix A, BCMAFF Environmental Programs). To determine the amount of land required see the following formulas. Land areas required for manure fertilization are discussed for confined livestock areas, seasonal feeding areas and grazing areas.

CONFINED LIVESTOCK AREA MANURE

Cattle in confined livestock areas are contained on sites where no crop is grown or where a crop is grown but the amounts of manure nutrients exceed the crop requirement. Manure from cattle in confined livestock areas needs to be collected, stored if necessary, and then spread as a fertilizer onto cropland. Acceptable minimum area required to spread manure from beef cattle feeders, can be calculated using the following formula (see example 9.1).

$$\text{Hectares} = \frac{\text{Animal Days} \times \text{Spreading Area Coefficient}}{10{,}000 \times \text{Adjustment Factors}}$$

- Animal Days based on 455 kg (1000 lb) animal.
- Spreading Area Coefficient shown in Table 9.2.
- The area can be adjusted by the manure application frequency: if manure is applied less than once every two years to a field the Adjustment Factor is 2.0.
- The area can be adjusted by the organic matter of the soil: for soil having 5 to 10% organic matter, the Adjustment Factor is 1.2, for soil having less than 5% organic matter the Adjustment Factor is 1.4.

It is recommended that all the manure be applied in the spring before crop growth. This will result in optimum crop yields without any risk of nitrate leaching over the fall and winter period. If manure application is split between spring and fall, leaching hazards will increase. Fall and winter applications should be less than 40% of the total amount of manure applied during the year.

SEASONAL FEEDING AREA MANURE

Most cow calf operations confine the herd onto a relatively small land base in late fall, winter and early spring. The primary source of feed is conserved forage transported onto the feeding area. Manure is deposited directly onto the land by the cattle while feeding.

TABLE 9.2
Spreading Area Coefficient For Beef Feeder Cattle Manure

Type of Crop Receiving Manure	Hectares Per 10,000 Animals Days on Feed (455 kg animals)				
	South Coastal	Kootenays	Okanagan Thompson	Central BC	Peace River
Cereals - Whole 2 cuts	—	—	4.2	—	—
- Whole 1 cut	22.0	9.4	6.9	13.2	12.0
- Grain only	10.0	—	13.8	—	55.0
Perennial Grass	3.9	6.3	4.3	13.5	—
Silage corn	6.3	—	6.1	8.1	—
50% Grass, 50% Legume	—	10.0	7.0	9.5	19.0

To convert to Imperial units 1 hectare = 2.47 Ac

This table assumes the following:

- water for crop growth is not limiting (i.e., this table is not for dryland conditions)
- average crop yields and nitrogen removal of various crops are explained in Appendix E.

EXAMPLE 9.1
Area Calculation For Spreading Beef Feeder Cattle Manure

What is the minimum area of corn silage land in Kamloops required to spread the manure from a confined livestock area (feedlot) that feeds 250 cattle for five months with an average weight of 365 kg (800 lb.)?

The manure is spread annually on soil of 6% organic matter.

The number of Animal Days: = 250 cattle x 5 months x 30 days
= 37,500 Animal Days

Animal Days based on 455 kg animal standard: $= 37{,}500 \times \frac{365\ kg}{455\ kg} = 30{,}082$ animal days

Spreading Area Coefficient from Table 9.2 for corn silage in Kamloops is 6.1 ha

Adjustment Factor for 6% soil organic matter is 1.2

Hectares $= \frac{\text{Animal Days x Spreading Area Coefficient}}{10{,}000 \times \text{Adjustment Factors}}$

$= \frac{30.082 \times 6.1}{10{,}000 \times 1.2} = 15.3$ ha

Conversion to acres = 13.3 ha x 2.47 ac/ha
= 37.8 acres

This feedlot should spread the manure on a minimum of 15.3 ha (37.8 ac) of land that will be planted to corn silage.

The distinction between a seasonal feeding area and a feedlot is that the amount of nitrogen from manure being deposited on the land *in a* seasonal feeding area does not exceed the needs of "the crop to be grown in the following growing season. If manure nutrient application is more than crop needs, then the site is more properly characterized as a confined livestock area.

The following formula is used to size the minimal seasonal feeding area for overwintering a beef cattle cow herd so the manure that is deposited during the feeding period does not exceed the requirement of the crop grown (see example 9.2).

$$\text{Hectares} = \frac{\text{Animal days x feeding Area Coefficient}}{\text{10,000 x adjustment Factors}}$$

- Animal days based on a cow or a cow and calf.
- Feeding Area Coefficient shown in Table 9.3.
- The area can be adjusted by the manure application frequency: if manure is applied less than once every two years to a field the Adjustment Factor is 2.0.
- The area can be adjusted by the organic matter of the soil: for soil having 5 to 10% organic matter, the Adjustment Factor is 1.2; for soil having less than 5% organic matter the Adjustment Factor is 1.4.

Cattle overwintering areas require a high degree of management to minimize the risk of polluting surface water with contaminated runoff. See section 4.2, Seasonal Feeding Area Evaluation and 4.3, Runoff Control and Collection.

GRAZING AND RANGELAND AREA MANURE

Intensively Managed Pasture. Intensively managed pasture is becoming more prevalent as a management practice. Maximum productivity of such pastures is achieved through use of irrigation water and regular applications of nitrogen fertilizer. Since the forage is not mechanically harvested and conserved some of the nitrogen in the forage is returned to the land in the form of manure. Research indikates that the potential for environmental contamination is greater from grazing systems than from systems where the forage is removed from the land. Therefore, it is important to ensure that the amount of supplemental fertilisation corresponds to the amount of nitrogen removed in the meat of the animals plus the amount lost through volatilization

Table 9.4 provides guidance on fertilization rates based on crop growth potential and time that the cattle are on pasture (see example 9.3). It is assumed that stocking rates are sufficient to harvest

TABLE." "9i3 ."
Feeding Area Coefficient For An OverWintering Site (Seasonal Feeding Area)

Type of Crop on Seasonal Feeding Area	Hectares Per 10,000 Animals Days on Feed (cow, or cow and calf)				
	south coastal	**Kootenays**	**Okanagan** Thompson" ,	**Central** BC	**Peace** River
Cereal - Whole 2 cut	—		3.3	—	
- Whole 1 cut	*17.0*	7.3	5.4	*10.2*	*9.3*
- Grain only	7.7		10.6		42.5
Perennial Grass	*3.0*	4.9	3.3	**10.4**	—
Silage Corn	**4.9**	—	**4.7**	**6.3**	—
50% Grass, 50% Legume		7.7	5.4	7.3	14.7

To convert to Imperial units 1 hectare = 2.47 ac
This table **assumes the** following:
. . water for crop growth is not limiting (i.e. this table is not for dryland conditions)
• average crop yields and nitrogen removal of various **crops are** explained in Appendix E.

EXAMPLE 9.2
Area Calculation For A Beef Overwintering Site (Seasonal Feeding Area)

What is the minimum area of a beef cattle overwintering site (seasonal feeding area) in Merritt for 250 cows for three months in a precalving area consisting of perennial grass which has 4% soil organic matter?

The number of Animal Days = 250 cows x 3 months x 30 days
= 22,500 Animal Days

Feeding area from Table 9.3 for perennial grass in Merritt is 3.3

Adjustment factor for 4% soil organic matter is 1.4

$$\text{Hectares} = \frac{\text{Animal days x Feeding Area}}{10{,}000 \times \text{Adjustment Factors}}$$

$$= \frac{22{,}500 \times 3.3}{10{,}000 \times 1.4} = 5.3 \text{ ha}$$

Conversion to acres = 5.3 ha x 2.47 ac/ha
= 13.1 acres

This overwintering site needs to have a minimum of 5.3 ha (13.1 ac) of land in perennial grass.

TABLE 9.4
Fertilizer Nitrogen Guide For Intensively Managed Pasture [a]

Crop Growth Potential (t/ha dry matter)	Length of Time Cattle on Pasture (months)					
	1	2	3	4	5	6
	fertilizer nitrogen kg/ha					
4	9	17	26	35	43	52
6	13	26	39	52	65	78
8	17	35	52	69	87	104
10	22	43	65	87	108	130
12	26	52	78	104	130	156
14	30	61	91	121	152	182

To convert to Imperial unit 1 kg/ha = 0.9 lb/ac
1 t/ha = 0.45 tons/acre

[a] See Appendix E for description of assumptions used.

EXAMPLE 9.3 Fertilizer Nitrogen Calculation For Beef Cattle On Intensively Managed Pastures.	
How much inorganic fertilizer should be added to a pasture that has a crop growth potential of 12 tonne/ha (5.4 tons/ac) that cattle are intensively grazing for five months?	
Suggested Maximum Nitrogen Fertilizer	= Table 9.4 value = 130 kg/ha Fertilizer Nitrogen
Conversion to lb/ac	= 130 kg/ha x 0.9 $\frac{\text{lb ha}}{\text{ac kg}}$ = 117 lb/ac Fertilizer Nitrogen
In order not to have excessive losses of nitrogen for this field, no more then 130 kg/ha (117 lb/ac) fertilizer nitrogen should be added.	

the entire amount of grass produced. If stocking rates are excessive and cause harm to the grass stand, then the site is more correctly characterized as a seasonal feeding area. If the pasture is only grazed part of the time and mechanically harvested the rest of the time Table 9.4 does not apply. Crop growth potential is an estimate of the amount of grass that could be harvested had the grass stand not been grazed.

Grazing on Rangeland. The stock rate of animals on rangeland is controlled by the carrying capacity of the range. This stocking rate is low (many hectares per animal). As a consequence, the risk of over application of manure causing pollution on rangeland is negligible when grazing.

9.6 MANURE SPREADING EQUIPMENT

Beef cattle manure spreading equipment should:

- be of tight construction so manure will not spill from it during transport (Figure 9.1);
- be operated in such a manner that the wheels do not carry manure onto public roadways; and
- be filled in such a manner that manure does not spill from the sides of the equipment creating unsanitary, messy conditions.

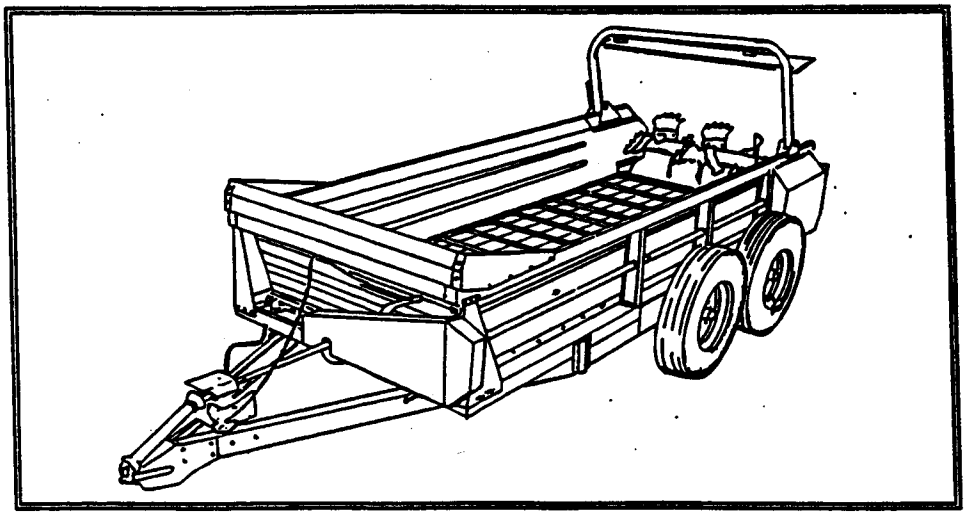

Figure 9.1 A Typical Solid Manure Spreader

ACRONYMS

AEPC	Agriculture Environmental Protection Council
ALDA	Agriculture Land Development Assistance
ARDCORP	B.C. Agricultural Research and Development Corporation
AUM	Animal Unit Months
BC	British Columbia
BCFA	B.C. Federation of Agriculture
BCMAFF	B.C. Ministry of Agriculture Fisheries and Food
BCMELP	B.C. Ministry of Environment and Parks
BCMF	B.C. Ministry of Forests
BOD	Biological Oxygen Demand
CCME	Canadian Council of Minsters of the Environment
COD	Chemical Oxygen Demand
CSERF	Community, Salmonoid Enhancement and Restoration Fund
DFO	Department of Fisheries and Oceans
DU	Ducks Unlimited
FBMP	Fraser Basin Management Plan
FO	Department of Fisheries and Oceans
FRAP	Fraser River Action Plan
HCF	Habitat Conservation Fund
HU	B.C. Ministry of Health and Welfare
IWP	Interior Wetland Program
KLPS	City of Kamloops
MOE	B.C. Ministry of Environment
NOSCG	North Okanagan Soil Conservation Group
SRWRC	Salmon River Watershed Round table Committee
U c c	University College of the Cariboo
USA	United States of America

ABBREVIATIONS & SYMBOLS

Ca	Calcium	dS	deci Siemens
EC	Electrical conductivity	g	Gram
H_20	Water	Ha	Hectare
K	Potassium	Kg	Kilogram
Mg	Magnesium	Mg	Mega grams
N	Nitrogen	NH4-N	Ammonia Nitrogen
NO3-N	Nitrate Nitrogen	O.M.	Organic matter
P	Phosphorous	SD	Standard Deviation
S04	Sulphate	Wt.	Weight