

**FRASER RIVER
ACTION PLAN**




Assessment of
Livestock
Wintering Areas
in Bridge Creek
Basin, 1996

DOE FRAP 1996-03



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ASSESSMENT OF LIVESTOCK WINTERING AREAS IN BRIDGE CREEK BASIN, 1996

DOE FRAP 1996-03

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1.0 INTRODUCTION

In this report the potential impacts of livestock wintering areas on water quality in the Bridge Creek basin are assessed. These sites had been inspected in the winter and spring of 1993-94 as a component of a broader evaluation of land use and water quality management in the basin (Hart, 1995). Following this study, BC Environment forwarded feeding area evaluations to each rancher and indicated that follow-up inspections would be carried out. The 1996 reassessment was designed to identify changes that had been made in winter feeding practices and to determine with ranchers any improvements which could be carried out to further reduce the likelihood of contaminated runoff flowing to streams or lakes. An additional purpose of this study is to evaluate livestock wintering area compliance with the environmental guidelines of the Ministry of Agriculture, Fisheries and Food (1992) and the *Code of Agricultural Practice for Waste Management* (Waste Management Act, Health Act, 1992).

Bridge Creek drains a 1,550 km² area of the Fraser River basin upstream from Canim Lake (see Figure 1). The largest community within the basin is the District of 100 Mile House located 80 km southeast of Williams Lake. Since Bridge Creek is the principal water source for 100 Mile House, maintenance of high water quality is critical. Lakes and streams throughout the basin are used for recreation and residential purposes and by fish and other aquatic species, thus their water quality is also a particular concern.

2.0 LIVESTOCK WINTERING AREA ASSESSMENT

In this study a system devised by Hart and Mayall (1990; 1991) is used, with some modification, to assess the potential for phosphorus delivery by surface runoff from a livestock wintering ground to receiving waters and to evaluate the potential water quality impact of this process relative to that of other classified sites. Although the focus of this study is on controlling phosphorus losses, agricultural runoff control also prevents impacts such as bacterial contamination, sedimentation, and lowered dissolved oxygen in streams and lakes.

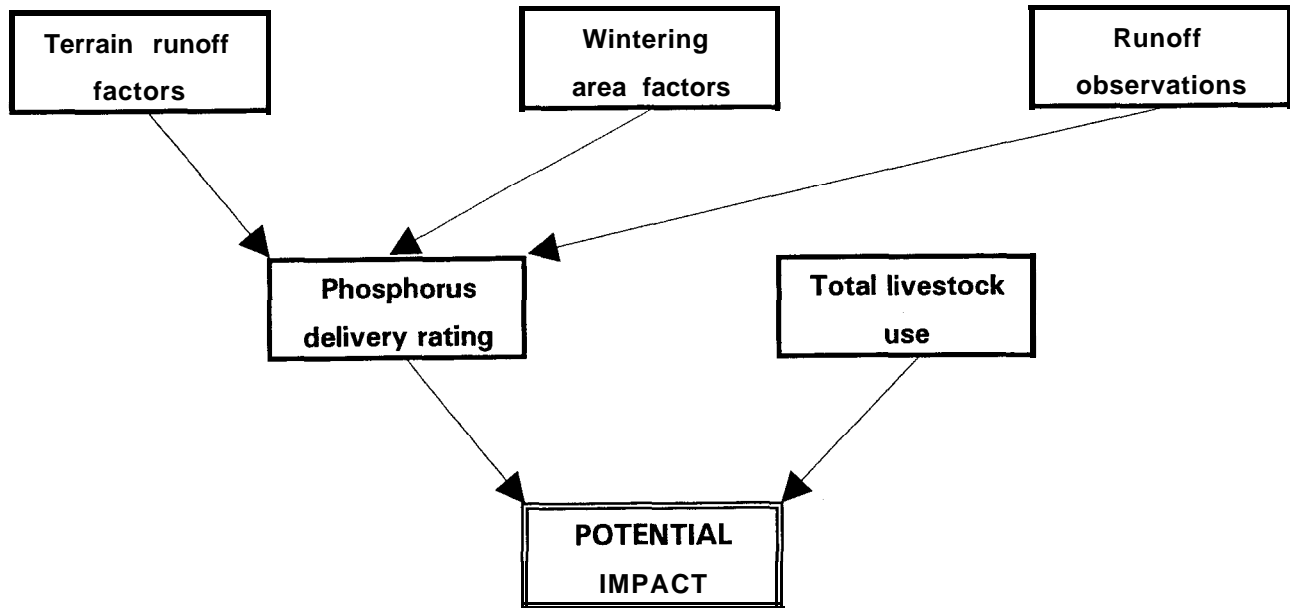
Hart and Mayall (1990; 1991) and Brown (pers. comm.) independently tried numeric systems to rate the factors controlling surface runoff from feeding areas; however, their studies revealed that, because the relative importance of these factors changes substantially from site to site and from year to year, a qualitative approach using a selection of site indicators without assigned values is more appropriate. A quantitative model would have to be relatively complex to produce valid results.

The emphasis of this assessment is on the susceptibility of feeding sites to phosphorus delivery by surface runoff. The risk of groundwater transport of contaminants is considerably lower due to the setback of feeding sites from watercourses and the high phosphorus retention capacity of the basin's soils. As well, in most cases measures to mitigate the risk of water pollution by surface runoff also control the risk of contaminated groundwater flowing to receiving waters. Where manure accumulations pose a risk of water pollution by groundwater flow the Ministry of Agriculture, Fisheries and Food (1992) *Environmental Guidelines for Beef Producers* are used as the basis for management recommendations (see section 2.2).

2.1 PHOSPHORUS DELIVERY AND POTENTIAL IMPACT RATING

The rating of the potential for phosphorus delivery from a feeding area to a watercourse or lake is based on terrain factors, feeding

Figure 2. Approach to determine potential impact of livestock wintering areas.



area characteristics, and snowmelt runoff observations (see Figure 2). In Appendix 1 the control exerted by these variables is briefly described.

The six terrain factors listed in Table 1 are classified to indicate how they might induce surface runoff to a low, moderate, or high degree. These terrain factors are inherent to the site that has been selected for livestock feeding and they are assessed independently of the influence exerted by livestock feeding practices themselves. The terrain conditions are considered both at the feeding site and along the drainage pathway from feeding site to receiving water.

Having evaluated the influence of terrain conditions upon runoff, the significance of specific wintering area characteristics is considered. The distance to receiving water and the wintering area

Table 1. Phosphorus delivery rating of livestock wintering areas.

CONTROLLING VARIABLE	Low	RATING Moderate	High
Terrain factors:			
Slope gradient (%)	<2	2-15	>15
Vegetation cover	forest	herbaceous	bare or annual crop
Soil drainage conditions	rapidly or well drained	imperfectly or moderately well drained	very poorly or poorly drained
Flood frequency	nil or rare	occasional	frequent
Runoff storage	good	limited	absent
Slope position	upper	mid-slope	lower
Wintering area factors:			
Setback distance (m)	> 200	100-200	<100
Wintering area - size (ha)	<1	1-4	>4
- orientation	across slope	intermediate	downslope
- livestock density (animal unit months/ha)	<40	40-200	> 200
Livestock water source	well-situated waterer	poorly situated waterer or restricted access to surface water	free access to surface water

Table 2. Potential impact rating of livestock wintering areas.

PHOSPHORUS DELIVERY RATING	TOTAL LIVESTOCK USE (animal unit months)		
	Low - < 200	Moderate - 200-400	High -
Low	low	low-moderate	low-moderate
Moderate	low-moderate	moderate	moderate-high
High	moderate	moderate-high	high

size, orientation on the slope, livestock density, and livestock water source are categorized to indicate their degree of control of runoff (Table 1).

Because of the subjective nature of this approach, direct observations of snowmelt runoff are particularly important. These observations can be supported by water samples to illustrate the degree of contamination, however no sampling was carried out during the present study.

The potential water quality impact rating of a feeding area is derived by scaling its phosphorus delivery rating by its total livestock use through the winter (see Figure 2) - that is, at the same site a larger number of animals would be assigned a higher impact (Table 2). Total livestock use is classified as <200, 200-400, and >400 animal unit months for the period of snow cover or frozen ground (see Table 2).

A selection of wintering area assessment coding forms with photographs (in lieu of maps) are appended to demonstrate this assessment methodology, the range of conditions at feeding areas, and typical mitigative measures that may be adopted (see Appendix 2).

2.2 ENVIRONMENTAL GUIDELINES FOR BEEF PRODUCERS

The Environmental Guidelines for Beef Producers (Ministry of Agriculture, Fisheries and Food, 1992) also provides a list of factors for rating the risk of water pollution by surface runoff and groundwater (although not a method to rate the relative impact of the process). The thresholds set for individual factors differ somewhat from those used in this study, however, the approach yields similar results. Both systems provide a checklist of variables whose relative importance must be assessed at the site, together with actual runoff observations if possible.

The Environmental Guidelines also provide a method of calculating the area required for crop assimilation of manure accumulated at a

livestock wintering area. Prolonged accumulation of manure in excess of crop requirements is detrimental to soil fertility and may pose a pollution risk to groundwater and nearby surface water.

In this project recommendations are made to ranchers for manure collection and spreading in accordance with the Guidelines wherever accumulations may result in surface water pollution by phosphorus movement in the soil. Since phosphorus is quickly tied up in study area soils, the sites most likely to cause pollution are confined livestock areas immediately adjacent to watercourses and lakes.

2.3 CODE OF AGRICULTURAL PRACTICE FOR WASTE MANAGEMENT

The *Code of Agricultural Practice for Waste Management* (Waste Management Act, Health Act, 1992) provides the regulatory authority in British Columbia for controlling water pollution caused by livestock wintering and other agricultural practices.

Key provisions of the Code relating to livestock wintering are that feeding areas:

- 'be operated in a way that does not cause pollution';
- 'have berms where necessary to prevent agricultural waste runoff from causing pollution';
- 'be at least 30 m from a high tide watermark, a watercourse or the bank of a watercourse, unless written permission has been obtained from the manager [employed by the Crown] for a closer location'; and
- 'be distributed throughout the area to ensure that manure from the feeding of livestock, poultry or farmed game is spread as a fertilizer or soil conditioner and that no accumulation of manure causes pollution'.

3.0 ASSESSMENT RESULTS

3.1 1993-94 WINTER

All ranches feeding more than 25 animal units¹ of livestock were inspected during the late winter and spring of 1994 (Hart, 1995). In total, 37 ranches were visited and 82 individual wintering areas were evaluated. The potential water quality impact at these sites was rated as follows: 42 low, 15 low-moderate, 21 moderate, and 4 moderate-high impact sites (see Table 3 listing by sub-basin).

3.2 1995-96 WINTER

Ranches wintering more than 25 animal units were visited again during the winter and spring of 1996. During this period all feeding sites determined to have a moderate or higher potential impact and most sites having a low-moderate impact were classified. For each of these sites, assessment coding forms were completed and discussions were held with ranchers regarding measures that could be taken to reduce water quality impacts.

The potential water quality impacts of the 85 feeding areas at the 34 ranches visited were classified as follows: 38 low, 23 low-moderate, 20 moderate, and 4 moderate-high (see Table 3). In most cases the moderate and moderate-high impact sites are out of compliance with the *Code of Agricultural Practice for Waste Management*: at nine sites this is due to their location within 30 m of streams or lakes, whereas at the remaining sites water pollution could likely be demonstrated. Strictly interpreted, the Code prohibits feeding within 30 m of any ditch, drainage line, or other feature which may intermittently convey flow to watercourses or lakes; by this measure most moderate impact sites would be found in

¹An animal unit is a standard defined as one mature cow with or without an unweaned calf. Animal unit equivalents include: weaned calves - 0.60; yearlings - 0.67; bulls and mature horses - 1.30; ewes with or without lambs - 0.20 (McLean, 1979).

violation of the Code without the necessity of proving water pollution.

Ranch locations are shown in Figure 1, although not the individual impact classifications (which are assembled in an addendum volume for B.C. Ministry of Environment, Lands and Parks). As Table 3 indicates, the majority of moderate and moderate-high potential impact sites are located within the upper basin area drained by Horse Lake (see Figure 1).

Table 3. Potential impacts of livestock wintering sites, 1994 and 1996 inspections.

Potential impact classes by sub-basin	Number of sites	
	1994	1996
Upstream from Horse Lake outlet:		
- low	31	27
- low-moderate	9	12
- moderate	12	16
- moderate-high	4	1
Downstream from Horse Lake outlet:		
- low	11	11
- low-moderate	6	
- moderate	9	4
- moderate-high	0	3
Total	82	85

4.0 PROJECTED IMPROVEMENTS

In the course of this project management changes were discussed with ranchers for all feeding sites which posed a water pollution threat. Following the 1994 inspections, several ranchers made an effort to bring their operations into compliance with the *Code of Agricultural Practice for Waste Management*, however, feeding practices worsened in some cases: 11 moderate or higher impact feeding sites were upgraded on 7 ranches; but, at another 7 ranches, 8 sites had higher potential impact ratings. A listing of the changes in livestock wintering practices at individual ranches from 1994 to 1996 is appended (Appendix 3).

All ranchers having moderate or higher potential impact sites (including some readily improvable low-moderate sites) have been sent the assessment coding forms for their feeding sites and a letter detailing BC Environment's understanding of their improvement plans. In total 17 letters were sent, documenting improvement plans for 15 low-moderate, 20 moderate, and 4 moderate-high potential impact sites. Fortunately all ranchers appear to have feasible methods of altering their operations to minimize water pollution. With few exceptions it is expected that the projected improvements would meet BC Environment's goal to upgrade all sites to at least a low-moderate potential impact classification.

During the summer and fall of this year, personnel from the Ministry of Environment, Lands and Parks and the Ministry of Agriculture, Fisheries and Food will be conducting follow-up visits to most ranches to inspect these improvements. Final inspections will then be carried out during the 1997 snowmelt runoff period.

5.0 SUMMARY AND CONCLUSION

In this project livestock wintering areas in the Bridge Creek basin were assessed to identify the management changes that had been made since the inspections during the 1994 snowmelt period and to determine with ranchers any further improvements that could be carried out to reduce water quality impacts.

Potential impacts of contaminated surface runoff from livestock wintering areas are evaluated using a rating system modified after Hart and Mayall (1990; 1991). For determination of manure management requirements at sites where accumulations jeopardize surface water quality by groundwater flow, ranchers have been referred to the *Environmental Guidelines for Beef Producers in British Columbia* (B.C. Ministry of Agriculture, Fisheries and Food, 1992). Compliance with the *Code of Agricultural Practice for Waste Management* is also evaluated; the Code sets out the minimum environmental standards required for operation of livestock wintering areas.

Since 1994, feeding site impact ratings have improved at 11 sites, but worsened at 8 sites. There remain 24 moderate and moderate-high potential impact wintering areas, some of which were used in 1994 and some that have been established since that time.

In 1994 the emphasis of the inspections was on identification of potential impacts, not on determination of specific means to improve feeding practices. Following these inspections, ranchers were informed of the impact ratings of their feeding sites and advised to make changes where required. The 1996 inspections were designed to focus more on planning of improved feeding practices. Indeed, these inspections revealed that this focus is necessary, there having been only limited net improvement since the 1994 inspections. Ranchers are still left to solve their own runoff problems, however, specific solutions were discussed in all cases and summarized in individual letters.

With few exceptions ranchers have feasible measures available to reduce water quality impacts to at least a low-moderate impact rating, BC Environment's objective for the Bridge Creek basin.

There is a clear need for planning of these measures with ranchers and for follow-up ranch inspections to assure that the changes are being put in place within a reasonable time period. It is also apparent that periodic monitoring would be beneficial to assure that changing feeding practices adhere to Code requirements. This monitoring programme should include an educational component relating to control practices and environmental impacts of agricultural runoff to streams and lakes.

In Bridge Creek basin BC Environment will be undertaking follow-up ranch inspections during the summer and fall of this year to assure that the feeding site improvements are being put in place.

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APPENDICES

APPENDIX 1. DESCRIPTION OF FACTORS APPLIED TO ASSESSMENT OF LIVESTOCK WINTERING AREA IMPACT

Terrain factors

Slope gradient:

- low - 0-<2%; moderate - 2-15%; high - >15%
- surface roughness elements and depressions are less likely to retain snowmelt as slope gradient increases
- surface flow velocity and runoff convergence along drainage lines increase with slope
- lower velocity flows have greater opportunity to infiltrate the soil
- snowmelt is more rapid on steeper slopes on southerly aspects

Vegetation cover:

- low - forest; moderate - herbaceous; high - bare or annual crop
- soil infiltration capacities are generally least for exposed soils (which are often compacted), intermediate for herbaceous cover, and highest for forest soils
- undisturbed forest soils have more frequent and larger roughness elements capable of retaining snowmelt
- frost penetration is lowest in soils protected by a forest canopy, litter, or herbaceous vegetation, and highest under bare soil
- the more gradual snowmelt in forests promotes meltwater infiltration
- the herbaceous cover of forest, grassland or hayland has a greater capacity for filtering runoff than bare soils

Soil drainage conditions:

- low - rapidly or well drained; moderate -imperfectly or moderately-well drained; high - very poorly or poorly drained
- the more poorly drained soils are the primary source areas of snowmelt and storm runoff by 'saturation overland flow' - where the groundwater table is at the soil surface, meltwater and precipitation cannot infiltrate and are either stored on the surface or run off
- imperfectly to moderately-well drained areas which occur along slope bases, drainage lines and other sites of drainage concentration are areas likely to become saturated and produce surface runoff during snowmelt
- coarse-textured soils (sands and gravels) have higher infiltration capacities and are less frost susceptible than fine-textured soils (silts and clays)

Flood frequency:

- low - nil or rare flooding; moderate - occasional flooding; high - frequent flooding
- flooding of feeding sites carries contaminants to receiving waters in most cases; 'frequent' refers to flooding once every 1 to 3 years (e.g., a low-lying floodplain or wetland fen) and 'occasional'

refers to flooding once every 4 to 25 years (e.g., a higher floodplain surface or alluvial fan)

Runoff storage:

- low - good; moderate - limited; high - absent
- water quality impacts are lessened where contaminated runoff is trapped by depressions, surface roughness elements, or structures such as berms and containment basins
- 'good' runoff storage implies total interception and storage of runoff produced at the feeding site; 'limited' refers to only partial runoff storage

Slope position:

- low - upper slope; moderate - mid-slope; high - lower slope
- lower slope (or 'receiving') sites intercept runoff from upslope and are generally closest to receiving waters
- upper slopes (or 'shedding' sites), hill crests, and sites where upslope runoff is diverted (for example by a ditch) are least likely to sustain surface runoff

Wintering area factors

Setback distance:

- low - >200 m; moderate - 100-200 m; high - <100 m
- distance is measured along the drainage pathway (not necessarily in a direct line)
- threshold distances are assigned in the rating system, although, in practice, sites are evaluated according to actual distance (for example, a site within 30 m of a watercourse poses a greater hazard than one within 60 m); the 100 m distance is based on results reported by researchers investigating attenuation of pollutant loads carried by sheet runoff across frozen surfaces - it should be recognized that concentrated flow along drainage lines can readily transport pollutants hundreds of metres to a channel
- setback distances less than 30 m (without written authorization) violate the Code of Agricultural Practice for Waste Management

Feeding site size:

- low - <1 ha; • moderate - 1-4 ha; high - >4 ha
- except in cases of low livestock density most snow and ice meltwater runs off the compacted, frozen surfaces of feeding areas
- the larger the feeding site the greater the probability of surface runoff being produced

Feeding site orientation:

- low - across slope; moderate - intermediate; high - downslope
- the downslope distance that runoff travels within a feeding area controls the opportunity for runoff to take place - where cattle are fed across a slope (along the contour) contaminants are less likely

to be entrained by runoff than if the feeding site is oriented downslope

Livestock density in feeding site:

- low - <40 animal unit months/ha; moderate - 40-200 aum/ha; high - >200 aum/ha
- the lower the livestock density in a feeding site the lower the availability of contaminants and the greater the opportunity for meltwater to infiltrate the ground
- manure produced by 40 animal unit months/ha approximates a grass-legume crop's annual nutrient requirements
- densities above 200 animal unit months/ha are typical of confined feedlots

Livestock use:

- low - <200 animal unit months; moderate - 200-400 aum; high - >400 aum
- the lower the livestock use of a site the lower the availability of contaminants
- total livestock use of a feeding site is used to scale its potential impact - i.e., a larger herd at a given site has a higher impact rating

Livestock water:

- livestock use of a natural water source may pose an additional pollution risk, especially if uncontrolled by fencing

Runoff observations

- direct observations of the snowmelt runoff process are the most important component of the assessment process
- susceptibility to dispersed or convergent runoff patterns is noted
- daily and yearly variations in runoff processes should be recognized
- water sampling and analysis of phosphorus concentration upstream and downstream of feeding sites can provide a clear indication of water quality impact

**APPENDIX 2. ASSESSMENTS OF REPRESENTATIVE WINTERING AREAS
IN THE CARIBOO REGION.**

LIVESTOCK WINTERING AREA ASSESSMENT

SITE: A

INSPECTION DATES:

WATERBODY:

AERIAL PHOTO:

PHOSPHORUS DELIVERY POTENTIAL:

Terrain runoff factors

Slope gradient : <2-5%

Vegetation cover : *herbaceous*

Drainage conditions : *well drained*

Flood frequency : *nil*

Runoff storage : *absent*

Slope position : *mid-slope*

Terrain runoff rating : *moderate*

Wintering area factors

Setback distance : *100m to creek*

Wintering area - size : *0.4ha*

- orientation : *across slope*

- livestock density : *low*

- livestock use : *low*

Livestock water : *waterer*

Runoff observations : *no runoff to creek observed*

Phosphorus delivery rating : *low*

WATER QUALITY: : *no sampling*

COMMENTS: : *small herd fed in narrow band across slope minimized runoff*

POTENTIAL IMPACT: low

SITE MAP:

Scale:



LIVESTOCK WINTERING AREA ASSESSMENT

SITE: *B*

INSPECTION DATES:

WATERBODY:

AERIAL PHOTO:

PHOSPHORUS DELIVERY POTENTIAL:

Terrain runoff factors

Slope gradient : 2-15%

Vegetation cover : *herbaceous*

Drainage conditions : *well drained*

Flood frequency : *nil*

Runoff storage : *absent*

Slope position : *mid to upper slope*

Terrain runoff rating : *low - mod*

Wintering area factors

Setback distance : *100m to floodplain; 250m to channel*

Wintering area - size : *0.8ha*

- orientation : *intermediate*

- livestock density : *moderate*

- livestock use : *low*

Livestock water : *waterer*

Runoff observations : *limited runoff to floodplain observed*

Phosphorus delivery rating : *moderate*

WATER QUALITY: : *no sampling*

COMMENTS: : *use of upper slope areas only recommended*

POTENTIAL IMPACT: : *low moderate*

SITE MAP:

Scale:



LIVESTOCK WINTERING AREA ASSESSMENT

SITE: C

WATERBODY:

INSPECTION DATES:

AERIAL PHOTO:

PHOSPHORUS DELIVERY POTENTIAL:

Terrain runoff factors

Slope gradient : <2%

Vegetation cover : *herbaceous*

Drainage conditions : *well drained*

Flood frequency : *nil*

Runoff storage : *limited*

Slope position : *upper*

Terrain runoff rating : *low*

Wintering area factors

Setback distance : *500m to lake*

Wintering area - size : *6ha*

- orientation : *intermediate*

- livestock density : *moderate*

- livestock use : *high*

Livestock water : *waterer*

Runoff observations : *limited concentrated surface runoff observed; no flow to lake*

Phosphorus delivery rating : *low*

WATER QUALITY: : *no sampling*

COMMENTS: : *low gradient, upper-slope site suitable for large herd*

POTENTIAL IMPACT: : *low*

SITE MAP:

Scale:



LIVESTOCK WINTERING AREA ASSESSMENT

SITE: *D*

INSPECTION DATES:

WATERBODY:

AERIAL PHOTO:

PHOSPHORUS DELIVERY POTENTIAL:

Terrain runoff factors

Slope gradient : *<2%*

Vegetation cover : *herbaceous*

Drainage conditions : *imperfectly drained*

Flood frequency : *occasional @ lower margin*

Runoff storage : *limited*

Slope position : *lower*

Terrain runoff rating : *high*

Wintering area factors

Setback distance : *30-50m from channel, but adjacent to*

Wintering area - size : *flood plain : 6ha*

- orientation : *across slope*

- livestock density : *moderate*

- livestock use : *moderate*

Livestock water : *creek*

Runoff observations : *runoff to inundated flood zone observed*

Phosphorus delivery rating : *high*

WATER QUALITY: : *no sampling*

COMMENTS: . *alternate site or extensive runoff containment required*

POTENTIAL IMPACT: : *moderate to high*

SITE MAP: Scale:



LIVESTOCK WINTERING AREA ASSESSMENT

SITE: *E*

INSPECTION DATES:

WATERBODY:

AERIAL PHOTO:

PHOSPHORUS DELIVERY POTENTIAL:

Terrain runoff factors

Slope gradient : *<2-5%*

Vegetation cover : *herbaceous*

Drainage conditions : *moderately - well drained*

Flood frequency : *nil*

Runoff storage : *absent*

Slope position : *lower*

Terrain runoff rating : *high*

Wintering area factors

Setback distance : *adjacent to drainage line*

Wintering area - size : *6ha*

- orientation : *intermediate*

- livestock density : *moderate*

- livestock use : *high*

Livestock water : *lake*

Runoff observations : *runoff along drainage line to lake observed*

Phosphorus delivery rating : *high*

WATER QUALITY: : *no sampling, but visibly contaminated*

COMMENTS: : *large feeding area produces considerable runoff; containment may not be feasible*

POTENTIAL IMPACT: : *high and alternate site recommended*

SITE MAP:

Scale:



LIVESTOCK WINTERING AREA ASSESSMENT

SITE: *F*

INSPECTION DATES:

WATERBODY:

AERIAL PHOTO:

PHOSPHORUS DELIVERY POTENTIAL:

Terrain runoff factors

Slope gradient : *<2%*

Vegetation cover : *herbaceous*

Drainage conditions : *imperfectly to mod-well drained*

Flood frequency : *occasional on lower slope*

Runoff storage : *absent*

Slope position : *lower*

Terrain runoff rating : *high*

Wintering area factors

Setback distance : *50m to channel*

Wintering area - size : *5.5ha*

- orientation : *downslope*

- livestock density : *moderate*

- livestock use : *high*

Livestock water : *creek*

Runoff observations : *runoff to creek observed; runoff from upslope crosses feeding area*

Phosphorus delivery rating : *high*

WATER QUALITY: : *grab sampling above and below site indicate elevated phosphorus loading*

COMMENTS: : *large lower slope site produces concentrated flow; runoff diversion and containment and greater setback required*

POTENTIAL IMPACT: : *high and alternate site recommended*

SITE MAP:

Scale:



Appendix 3. Changes in livestock wintering practices, 1994-96.

Ranch code*	Number and impacts of feeding sites		Description of changes in wintering practices
	1994	1996	
602	1 - low	1 - low	unchanged
678	2 - low 1 - low-moderate	3 - low 1 - low-moderate 1 - moderate	1994 sites unchanged; two new sites assessed
895	1 - low-moderate 1 - moderate	1 - low-moderate 3 - moderate	1994 sites unchanged; two new sites assessed
326	2 - low	2 - low	unchanged
959	1 - moderate	1 - moderate	fencing of livestock 30 m from creek almost completed
558	1 - low	1 - low	feeding site moved
353	1 - low 1 - low-moderate	1 - low 1 - low-moderate 1 - moderate	1994 sites unchanged; one new site assessed
577	1 - low 1 - low-moderate	1 - low 1 - moderate	feeding sites unchanged; low-moderate site reclassified as moderate
866	1 - low	1 - low	feeding site unchanged
305	2 - low	2 - low	feeding sites unchanged
813	2 - low	2 - low	feeding sites unchanged
189	1 - low-moderate 1 - moderate	3 - low-moderate 1 - moderate-high	use of livestock confinement along creek curtailed; one higher impact site used
878	1 - low 1 - low-moderate 1 - moderate	1 - low 2 - low-moderate 1 - moderate	wintering practices unchanged; one site reclassified as two
683	1 - low 1 - low-moderate 6 - moderate	1 - low 2 - low-moderate 2 - moderate	four sites close to creek abandoned; one new low-moderate site occupied; two moderate sites remain unchanged
285	1 - low 1 - low-moderate 1 - moderate 1 - moderate-high	2 - low-moderate 2 - moderate	two sites unchanged; moderate-high site improved to low-moderate; new moderate site occupied

*Ranches are coded by random number to maintain confidentiality.

...cont'd.

Appendix 3, cont'd.

Ranch code	Number and impacts of feeding sites		Description of changes in wintering practices
	1994	1996	
442	1 - low	1 - low	feeding site further back from creek
862	1 - low	1 - low	site well back from lake; not reinspected
848	1 - low 1 - moderate-high	3 - low	moderate-high site abandoned; two new, low impact sites occupied
569	3 - low 1 - low-moderate 3 - moderate	1 - low 1 - low-moderate 1 - moderate 2 - moderate-high	numerous site changes, but not resulting in overall improvement
831	1 - low	1 - low	feeding site unchanged
555	2 - low	2 - low	feeding sites unchanged
470	2 - low	2 - low	feeding sites unchanged
689	1 - low-moderate	1 - low-moderate	feeding site unchanged
364	1 - low 1 - low-moderate	1 - low 1 - low-moderate	feeding sites unchanged
957	2 - low	1 - low 1 - low-moderate 1 - moderate	one site unchanged; a slight relocation of one site increased potential impact; one moderate impact site occupied
267	1 - low	1 - low	feeding site unchanged
426	1 - low 1 - moderate	2 - low 3 - moderate	three new sites assessed; no improvements at established sites
954	1 - low	1 - low	feeding site unchanged
952	1 - low 1 - low-moderate	1 - low 1 - low-moderate	feeding sites unchanged
669	2 - low 1 - low-moderate 1 - moderate	2 - low 3 - low-moderate	three sites unchanged; moderate site upgraded to two low-moderate sites
174	1 - low 1 - low-moderate	no sites	no livestock in 1996
215	1 - low-moderate 1 - moderate	3 - low-moderate	feeding sites shifted to upgrade moderate site to two low-moderate sites

...cont'd.

Appendix 3, cont'd.

Ranch code	Number and impacts of feeding sites		Description of changes in wintering practices
	1994	1996	
571	2 - low	1 - low 1 - moderate	downslope relocation of one feeding site increased potential impact
310	2 - moderate	1 - moderate	fewer livestock being fed - only one site in use
697	2 - low 1 - moderate 1 - moderate-high	no sites	ranch now owned by ranch 895
905	1 - low 1 - moderate 1 - moderate-high	1 - low 1 - moderate 1 - moderate-high	feeding sites unchanged
Total:	42 - low 15 - low-moderate 21 - moderate 4 - moderate-high 82 - total	38 - low 23 - low-moderate 20 - moderate 4 - moderate-high 85 - total	

