

**CARIBOU MATERNITY PENNING PROTOCOLS AND
GUIDELINES
MATERNITY PENNING PROJECT**



REVELSTOKE CARIBOU REARING IN THE WILD SOCIETY

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1. BACKGROUND AND PURPOSE

This document outlines animal handling, husbandry and operational procedures and protocols for the Revelstoke Caribou Rearing in the Wild's (RCRW) maternity penning project. The first version of this document (V1.0) was written by Kellner (RCRW) and Serrouya (RCRW) in February 2014 with input from several others. A review of animal husbandry procedures was conducted by Dr. Bryan Macbeth (RCRW) in August 2015. In 2017, an update of the protocols (V2.1 - DRAFT) was developed by Kelsey Furk (RCRW) to implement recommendations from the 2015 review with additional guidance from Dr. Caeley Thacker (RCRW). Dr. Thacker attended the 2016 calving season and had unique insight into animal husbandry protocols. V2.1 – DRAFT was not finalized. V3.0 was finalized by Cory Legebokow (Province of BC) in collaboration with Bill Beard (RCRW), Dr. Helen Schwantje (Province of BC) and several others. It includes the V2.1 DRAFT updates without the discussion related to project background & rationale, objectives & approach and measures of success. It focuses solely on animal handling and husbandry procedures and protocols from capture through release & monitoring in addition to facility operations and maintenance standards in effect for the projects last year of operation in 2018. Information on project rationale, objectives, progress and results can be found in the final project report published on the Alberta Biodiversity Monitoring Institute (ABMI) Caribou Monitoring Unit (CMU) website at [ABMI-CMU webpage](#).

2. ANIMAL CARE, HANDLING, AND HUSBANDRY

2.1 CAPTURE PRINCIPLES AND PROTOCOLS

The RCRW maternity pen trial goals require up to 20 adult females to be captured annually from the Columbia North caribou herd; however, this is not always possible for a variety of reasons. The number of caribou captured is re-evaluated annually to reflect experiences from previous years, logistics, weather and other factors.

Caribou capture is performed by highly experienced crews with a large ground support group to maximize animal health and welfare. Briefing sessions are held the evening prior to the first capture day and all operational logistics are thoroughly discussed. The following principles will be followed and applied using adaptive management.

2.1.1 CAPTURE PRINCIPLES

1. Crew briefings ([Appendix 1](#)) are led by the Incident Commander and the Field Capture, Pen Team and ground Transport Crews are assigned tasks, crew leads and duties.
2. Capture date and selection of animal groups for cow capture are chosen in consideration of avalanche risk, snow stability, weather, terrain, transport time and safety risks to crews and caribou. The RCRW Capture Safe Work Procedures ([Appendix 2](#)) apply. Additional training is reviewed during the briefing and must be followed during the captures. Captures may be required over multiple days based on factors such as the target number of animals, weather, avalanche conditions, and personnel or equipment availability
3. In the field, further briefings include helicopter safety and logistics for all crews working closely with the aircraft and animals.

4. Capture crews will discuss the targeted groups and capture order, including individual animals and cow/yearling groups. Capture sites are evaluated on a case-by-case basis. Caribou in proximity to dangerous terrain (cliffs, avalanche hazard) will not be approached.
5. The primary goal is to capture healthy adult female caribou, preferably without yearlings at foot. Capture by net gun delivered nets is the only capture method used.
6. The preference is to capture all caribou in small groups if they it is safe to do so. Group size is not to be reduced to less than three (i.e. if there are 5 take no more than 2). Bulls could be left in groups smaller than 3.
7. Close chase (approach just prior to capture) times are to be minimized to less than 2 minutes and the number of chases of a group is limited to 2-3 incursions.
8. Locations to capture animals are chosen to minimize animal transport times and to minimize the time between chase and release into the pen.
9. A wildlife veterinarian will be present during most capture operations. The veterinarian or designated capture personnel are responsible for an examination of each captured animal for suitability for penning. A suitable animal is; female, in good body condition, not suffering from a severe injury and with a rectal temperature of < 41 C. Animals with body temperature >41 degrees Celsius are released in the field. No bulls will be transported to the pen.
10. Suitable cows are sedated by the designated individual using intranasal administration of medetomidine, once sedated each animal is hobbled and placed into a transport bag, lifted into a second helicopter and transported to the pen with a designated individual maintaining a correct body position and monitoring the animal until arrival at the unloading site.

2.1.2 CAPTURE & HANDLING PROTOCOLS

BC caribou capture and handling protocols are used, which are modified from those used for the Level-Kawdy/Purcell translocation (Kinley 2010) and regional operations. These are summarized as:

1. Close approaches allow the pilot to isolate the target animal and steer them into the most suitable terrain and snow depth and slow the animal so that the net gunner can successfully place a net on the correct animal.
2. If the net does not place well and an additional net is required, the crew will deploy the second net as fast as possible.
3. Immediately after capture, a second helicopter with a transport crew will land to assist with an examination of the cow, including temperature recording, sedation if the animal is to be transported, untangling the animal from the net, hobbling, applying eye lubrication and a blindfold.

4. The ideal animal is a healthy mature female that is relatively young (assessed by inspecting incisors) with a rectal temperature of less than 40 C. It is not possible to determine pregnancy status in the field. Lactating females are released unless their yearling is also being transported to the pen (i.e. in the case that a whole group including a cow/calf pair captured).
5. Any caribou with a rectal temperature of greater than 41 C is released.
6. Injured, aged or bull caribou will be released when recognized.
7. Any animal not considered releasable due to severe injury, e.g. from a broken neck or leg during capture, will be euthanized. The method of euthanasia is gunshot to the head (AVMA 2013) with a necropsy performed later by a project veterinarian.
8. Caribou to be transported to the pen are sedated with medetomidine administered by an intranasal nebulizer. Doses ([Appendix 3](#)) are modified from protocols originally developed for the Level-Kawdy/Purcell translocation.
9. Sedated caribou, once hobbled and blindfolded are placed in custom-designed bags, lifted into the back seat area (seats removed) and transported in the transport helicopter. A designated crew member accompanies the animal(s) during the flight to; record any pertinent information from the capture and animal examination, maintain the correct body (head) position and prevent the animal(s) from moving in the machine and to monitor the animal(s). Two animals may be placed side by side if an adequate amount of space is present to ensure safety.
10. If two caribou are captured and are being transported, the capture crew will remain on standby until the transport helicopter returns from the pen before starting a new round of captures.
11. The transport helicopter will land at the designated drop-off area 200m from the pen without overflying the pen to reduce helicopter disturbance to penned animals.
12. Unloading animals will require additional crew to lift and carefully move animals from the helicopter. This crew will carry the animal to a snowmobile skimmer padded with thick padding. A crew member will sit in the skimmer with the caribou head on their lap to ensure proper head position (head up, nose down) at all times while the animal is in the skimmer.
13. Two processing areas are set up in the pen with two veterinarians and associated crews. Each animal is lifted from the skimmer, placed on a platform scale and weighed, then lifted to a plywood platform or snow and removed from the transport bag.
14. Further handling, sampling and processing is conducted in accordance with the following procedures:
 - i) Handling crews are assigned tasks and each crew will have a recorder responsible for recording all data including information from the capture, samples collected, and other monitoring information.

- ii) Each animal is assigned a unique animal Wildlife Health ID # and a pre-prepared sampling kit.
 - iii) Rectal temperature is recorded and, if a concern, action is taken to cool the animal with snow packing of the ventral surface. A physical examination is performed and includes assessments of:
 - general health
 - body condition score (BCS) - from 0 (emaciated) to 5 (excellent)
 - external parasites
 - presence of *Besnoitia* cysts on the eye sclera and limbs
 - lactation status
 - dental exam for age estimation – with photographs
 - i) Samples are collected and include:
 - 35 ml blood – for various health parameters and pregnancy status
 - 6 mm ear biopsy
 - 100 hairs from between the shoulder blades
 - 20-30 fecal pellets – from anus or bag or field collection
 - i) ear tags with a set colour pattern and number are applied in each ear using an ear tag applicator
 - ii) a GPS collar with a rot-off will be fitted on all animals not previously collared.
 - iii) rump fat assessment by ultrasound is performed according to Cook and Parker.
 - iv) each animal is treated with the following prophylaxis:
 - Larvicidal anthelmintic
 - NSAID anti-inflammatory
 - Selenium/Vitamin A combination
 - If indicated, antibiotic injection
17. Once all procedures are complete the blindfold and hobbles are removed and sedation reversed with an intramuscular injection of atipamezole and the animal observed until recovery.
18. All data is recorded in the BC Caribou Maternity Penning Data Form_2018_V1.0 ([Appendix 4](#))

2.2 IDENTIFICATION OF CAPTURED ANIMALS

All caribou released into the pen are fitted with two small individually numbered and colour-coded (unique to year) ear tags. Adults are fitted with a satellite linked GPS/VHF radio-collar, with mortality sensor. Collars will have colour coded duct tape to easily identify individuals in the pen, and for up to a year after release. Adult collars are fitted with a cotton rot-off to ensure the collar eventually falls off. Calves (if captured in the pen) are fitted with a single ear tag and specific calf collars with colour coded duct tape that matches their mother. Calf collars (VHF) are light weight, expandable and include a cotton rot off designed to allow removal approximately 1 year after application.

2.3 QUARANTINE/HYGIENE AND VISITATION PROCEDURES

A health risk assessment of captive caribou was performed by Sifton (2001). Sifton stated that the risk of developing or having various infectious diseases ranged from low to moderate. Beyond initial screening for the diseases that can be assessed, and rejection of animals in obvious ill health, standard hygiene practices are expected to prevent/avoid diseases and parasitism. However, to best reduce the risk of transferring disease to or from captive animals, penned caribou are considered to be in permanent quarantine while in the pen. Husbandry efforts by the staff are to focus on the prevention of the transfer of human and animal material (feces, urine, saliva) on equipment, clothes, or shoes, to or from the site. No domestic animals are permitted access and other visitation is limited to prevent disturbance.

Measures to ensure biosecurity include:

- Controlled access - access into the pen area is restricted to project staff, veterinarians and select visitors.
- All staff and visitors *must* follow *all* quarantine procedures.
- Visitation is restricted to those that have a clearly defined need for:
 - operational requirements (i.e. emergency pen maintenance)
 - project sustainability and extension
 - scientific inquiry.
- Unless necessary (emergency maintenance) visitors will only have access to the main blind (max 3 people), will never enter the pen, and shall only approach the pen under the direct supervision and guidance of shepherds or other project staff.
- No staff or visitors will wear clothing or footwear that has been used on a farm. Clothing dedicated to the project will be used by staff. Staff and visitors will wear clean clothing.
- Dogs living at the outfitting lodge will not be allowed to enter the area around the pen and will be kept out of the pen during the off season. Staff will not bring pets to work.
- Staff will wear disposable latex or nitrile gloves and clean dedicated coveralls for capture of calves.
- Staff will use dedicated boots that are provided (in a range of sizes) at the main gate for use in the pen.

- Boot washes – disinfectant boot-washes will be set-up and maintained outside the pen area at every entrance. Boots must be cleaned upon arrival/departure and entering the pen area. Suitable disinfectant footbaths include Quatsyl-D™ (alkyl benzyl dimethyl ammonium chloride at 4.0%) and Dettol (4-chloro-3,5- xyleneol at 4.8% and pine oil at 8.4%, dilute at approximately 85ml/L of water). Footbaths should be changed at least 2-3 times a week, more frequently if they have accumulated dirt and organic material.
- Hand sanitizer – must be used prior to entering the pen for any reason.
- Equipment – all feeding and cleaning equipment should be used exclusively in the pen areas. If this is not possible then all equipment must be cleaned with an appropriate disinfectant before being used in the pen area
- Cleanliness – food and water troughs must be cleaned regularly (feed and water troughs every 2 days); unused feed will be weighed, recorded and disposed of outside the pen, and in a manner that will not attract wildlife. Feed will be cleaned up below troughs regularly. Any unusual findings will be recorded, such as poor feeding, large muddy areas, etc.
- Feces will be spot cleaned during penning operations with a thorough clean-up as soon as possible after release. This involves raking up fecal pellets and associated duff in high-use areas and depositing it in dedicated areas located throughout the pen.

2.4 FOOD AND WATER IN CAPTIVITY

On entry to the pen, caribou are fed a mixture of arboreal lichen and caribou pellets and will have free access to green vegetation as it grows in the pen. Food is equitably distributed amongst a minimum of 1 agricultural-type HDPE plastic 10' long feed trough per 4 adults. Troughs are covered to protect pellets from rain and snow and are placed in areas easily visible from the main observation blind.

Arboreal lichen is collected well in advance of each annual penning cycle at locations outside of caribou habitat from either standing or freshly-fallen trees in recent cut-blocks. A specific protocol for picking, processing and storing lichen is provided in ([Appendix 5](#)). Lichen collection targets *Bryoria* species and *Alectoria sarmentosa*. Lichen is picked, dried at room temperature and placed into mesh soccer-ball bags and stored outdoors in a well-ventilated covered area. The target for lichen collection for each annual penning cycle is 15 kg/adult caribou.

Initially, 90% lichen and 10% pellets is placed in the feeding troughs. Pellets are gradually introduced to the cows over 10 days at a rate of approximately 10% change/day. As a rule, all feeding changes must be gradual to prevent digestive upsets and feces will be monitored to detect digestive issues. To minimize rapid consumption and potential for choking and especially during transition to pellets, medium (i.e. small apple) size clean smooth river rocks are added to troughs to slow down feeding and discourage 'gulping'. Since cows are often thin in late winter, feed transition and consumption is very important during the prepartum and postpartum period.

Pellets for the first and second year of the project (2014 & 2015) were manufactured at a feed mill by Unifeed in Okotoks, Alberta (Unifeed 15% Caribou Pellets – Feed Tag Code 19-3702: [Appendix 6](#)) formulated from a recipe customized for caribou (Dr. Kathy Parker, University of Northern British Columbia). Starting in 2016 pellets were purchased from the Wetaskiwin Co-op Assoc using the Calgary Zoo Winter Herbivore diet (Formula code M800710: [Appendix 7](#)). Pellets are fed ad libitum after the initial transition from the wild diet. Feed troughs should be well spaced (i.e. 10m apart) and at least 25m from the main blind. Caribou may be disinclined to visit troughs near human presence, especially immediately after capture and during calving. Troughs are cleaned of excess feed every 2 days and hosed clean once/week and allowed to dry.

Animals are fed at a rate of 3.2 kg feed/adult/day (J. Cook, pers. comm.). Extra pellets should be available during lactation when caribou may consume up to 6 kg feed/adult/day. Animals will be eating green vegetation in the pen in early summer and may not need to be transitioned back to natural food before release (J. Cook, pers. comm.).

Water is provided via a flow-through solar powered system (installed in spring 2016) pumped directly from Lake Revelstoke. This system had 2 stations in 2016 and 3 stations in 2017 & 2018, each with one or two elevated 6 m lengths of 20 cm (8”) diameter PVC gasket pipe with 1/3 of the circumference removed lengthwise to function as water troughs. Water depth is controlled by a standpipe at the discharge end of each trough. This allows water to be available when inlet flows cease overnight. At least one trough at each station needs to be low enough to allow calves to drink. Water troughs are checked daily and cleaned approximately every 2 days. The solar powered watering system is to be activated as soon as temperatures allow (Refer to Section: [8. Enclosure details and maintenance](#)). All components of the watering system meet potable water specifications. A critical issue is to avoid muddy areas that create environments for cooling and attracting animals to bed. While this is less concerning for adults it may serve as a source of contamination and foot issues. Wet, fecal contaminated areas are highly concerning for calves, especially during neonatal periods when they are likely to develop umbilical infections.

2.5 DAILY ROUTINE

The site will be continually staffed by a minimum of 2 people, including 1 lead shepherd preferably experienced in wildlife and predator management and ideally knowledgeable of animal behaviour and husbandry. Shepherds will work in 8-hour shifts, staggered during the day to provide maximum coverage. Shepherds will be on call during off-hours.

The caribou and enclosure will be monitored 10-12 h/day during daylight hours. Tasks for monitoring include:

1. Daily pen/fence assessment and maintenance/predator patrol:
 - a. shepherds will patrol the perimeter of the enclosure, at least twice per day to assess for fence integrity and evidence of predators. Patrols may be reduced to once/day during calving or when animals may be sensitive to disturbance. Any

- fence issues must be fixed immediately, and each issue documented (what they were and what the fix was),
- b. inspect and rake 'track traps' if used,
- c. check fence voltage twice daily to ensure it is greater than 5 Kv,
- d. if predators or sign are identified in the area, patrols will occur more frequently (Refer to Section: [6.1 Decision tree for response to predators](#)),
- e. maintain cameras and view photos/videos - every second day, replace data cards from all remote detection cameras with new blank cards. Using the project laptop computer, view data card files for predators, and save photos. Each morning review photos received on the project laptop that may have been transmitted overnight by the BuckEye remote wireless transmission camera system. If predators have been detected refer to (Refer to Section: [6.1 Decision tree for response to predators](#))
- f. record minimum and maximum air temperature in afternoon from wireless digital thermometer located in a shady spot inside the pen,
- g. update the Shepherd Daily Log ([Appendix 8](#)) and document
 - i. fence condition and repairs,
 - ii. electric fence voltage,
 - iii. predator sign,
 - iv. min/max temperatures and general weather conditions,
 - v. bootwash changes,
 - vi. feed amounts (kg) and discarded (kg), troughs cleaned
 - vii. water system inspection and cleaning
 - viii. scale taring and camera data card viewing
 - ix. visitors
 - x. other relevant information

2. Animal observations

- a. Each animal will be observed at least twice per day, to confirm identity, if they are feeding/drinking, what they are eating and that they are healthy and uninjured,
- b. for cows, at least 1 check must be visual to confirm they are healthy. Other checks may rely on radio-telemetry signals. For calves, both checks must be visual,
- c. a photo of each caribou will be taken and logged at least once every 2 weeks,
- d. any animal health issue will be immediately documented. Photographic records should be collected immediately either using the DSLR camera in video mode or by using the Pan-Tilt-Zoom (PTZ) camera system,
- e. for the period two weeks before calving, and one week after the last calf is born, please refer to protocols detailed in Section: [3 Calving](#),
- f. all observations, visual or telemetry-based, will be recorded in an Individual Daily Observation Record ([Appendix 9](#)) documenting:
 - i. when the animal was seen,
 - ii. any unusual behaviour
 - iii. body condition, and a head to toe check

- iv. food and water intake
- v. presence, condition, behaviour of calf

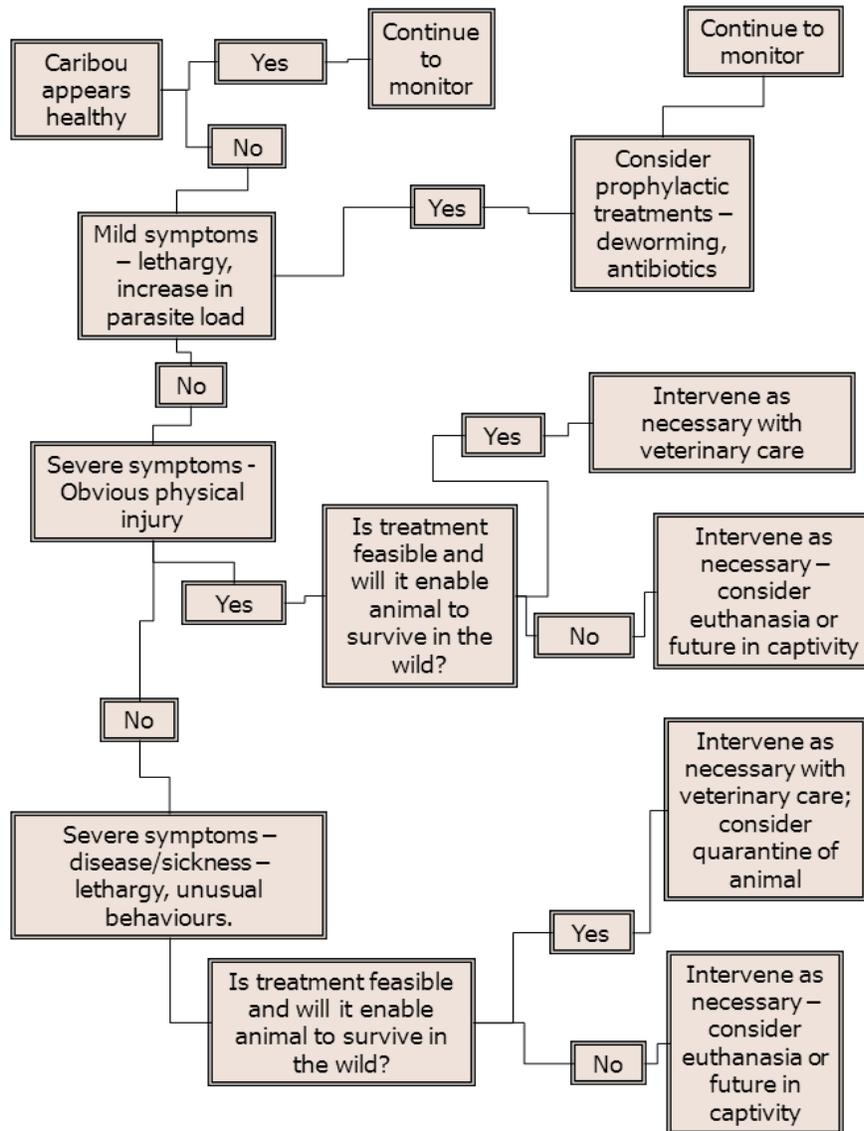
3. Feeding

- a. Troughs will be cleaned of left-over pellets and other material every 2 days or daily if it becomes wet. Leftover feed is weighed and recorded in the Shepherd Daily Log ([Appendix 8](#)),
- b. Lichen/pellets are provided by entering the pen and filling the troughs approximately every 8-12 hours. Refer to Sections: [2.4 Food and water in captivity](#) for transition from lichen to pellets; and [2.3 Quarantine/hygiene and visitation procedures](#). Enough feed is to be provided to ensure there is always feed available,
- c. Pellets used in 2016 appeared to disintegrate easily and produced a fine dust which may have caused some cows to choke and/or cough. If excessive dust is present it is to be removed by sifting the pellets prior to feeding,
- d. Medium (i.e. small apple) size clean smooth river rocks are added to the troughs to slow pellet consumption and help prevent 'gulping.'
- e. Clean water will always be available when snow is not available (see details in section [2.4 Food and water in captivity](#)). The solar powered watering system should be operational as soon as possible once freezing weather subsides and must be available prior to the last clean snow melting from within the pen,
- f. Water troughs need to be checked daily for function and need to be cleaned every 2 days or sooner if dirty. Muddy areas should be reported and mitigated as soon as possible
- g. Fecal samples will be collected when unusual feces are observed and analyzed by a local veterinarian to check for parasite levels.

2.6 VETERINARY CARE

Caribou will be visually monitored daily for general health and behaviour as above. All observations will be recorded on Individual Daily Observation Record forms ([Appendix 9](#)). Veterinary assistance/intervention will be provided as needed based on professional opinion (Refer to Section: [2.7 Decision Tree for Veterinary Intervention/Assistance](#)). Decision trees regarding animal health must be posted in the main blind for reference in addition to the Caribou Body Condition Score Chart ([Appendix 10](#)) and the Caribou Illness Reference Card ([Appendix 11](#)).

2.7 DECISION TREE FOR VETERINARY INTERVENTION/ASSISTANCE



If an animal health condition is reported, a collaborative discussion between biologists, shepherds and veterinarians will occur and veterinary intervention will occur as soon as possible. Video recording and photos are valuable tools for communicating potential issues to veterinarians and should be obtained as soon as possible upon discovery of any concerns. Sedation, immobilization and/or euthanasia will be carried out as required after discussion by veterinary staff. The project goal is zero mortality; however, any morbidity or death will be thoroughly assessed, investigated and diagnosed; mitigation to occur as soon as possible. Any mortalities, natural or from euthanasia, will be documented in the BC Caribou Research Program - Mortality Site Investigation Form ([Appendix 12](#)) and a necropsy by a veterinarian according to a standard protocol as soon as possible. Carcasses may be transferred to a freezer in Revelstoke for storage if a necropsy is not possible on

site. Photograph and video the mortality site prior to disturbing the area. Supplies to be available in case of emergency:

- Extra-large, screw together padded dog kennel for calf transport.
- Coolers and frozen water bottles for transporting samples
- Formalin, whirl packs, garbage bags, sharp knives (or scalpels) and markers
- Envelopes for DNA samples.
- Veterinarian will provide other materials and tools for sedation, immobilization, treatment and necropsy.

3. CALVING

3.1 COW CARIBOU BEHAVIOUR

The calving period encompasses roughly the 2 weeks leading up to calving, delivery of a calf (parturition), and a week after calving; there are specific considerations during this period that differ from other times. Caribou cows should develop larger udders during the last two weeks of gestation. Closer to parturition they may exhibit pacing, separation from other cows, less appetite or more secretive behaviour. Visibility in the enclosure makes observation of calving very difficult, and it is unlikely that normal delivery of calves will be observed.

Parturition occurs in stages – the final delivery follows a series of strong uterine contractions. Calves are usually born feet first with the head tucked between the forelegs. The cow may be standing or lying down. The birth starts with the passing of the amniotic sac and usually proceeds quickly, taking less than 30 minutes before the calf is on the ground and being licked by the cow. The calf will be covered with fluid and membranes and the licking stimulates the calf to move and rise. The afterbirth should follow the calf within hours and is generally consumed as well. Occasionally the placenta is not completely passed and membranes may be visible at the vulva opening.

The healthy newborn calf will try to rise within 10 to 20 minutes and will nurse almost immediately. The first milk, known as colostrum, has very high protein levels due to the excretion of antibodies with the milk. It is essential for the calf to consume colostrum in the first few hours of life for protection from infectious diseases; this is called passive transfer of immunity.

Cows with newborn calves may remain secretive for several days post-calving, even if the calf is normal and healthy. The cow may ‘stash’ the calf in a warm dry area and forage alone, returning to the calf repeatedly to allow it to nurse. Alternately, cows may stay with their calves away from the rest of the herd.

3.2 HUMAN OBSERVATIONS AND PROTOCOLS DURING CALVING

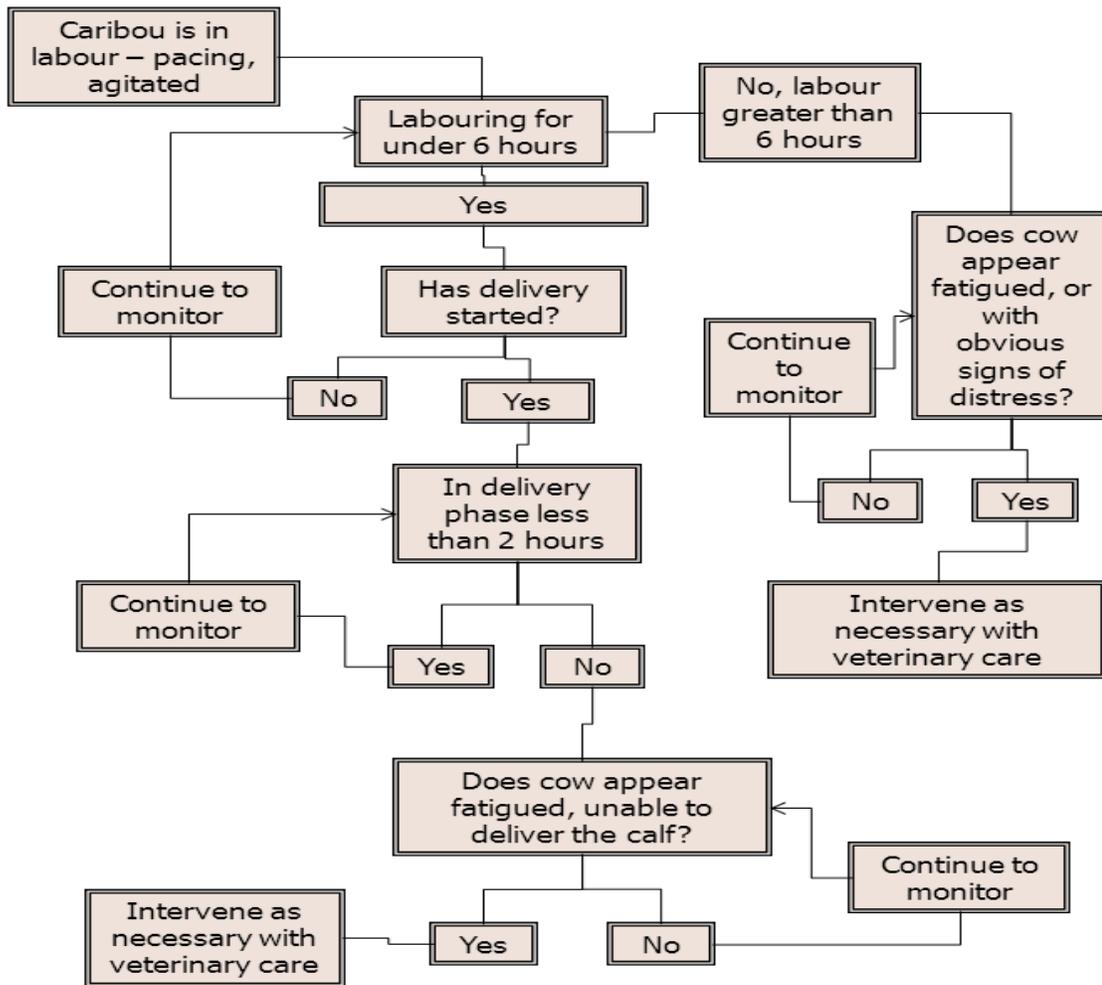
During the calving period, the number of observers may need to be increased to determine when calving occurs and to monitor the health and well-being of cows and calves. Visual checks on each animal will be made at least 2 times per day. However, care must be taken to limit the disturbance of cows and calves. It is essential that cow-calf pairs not be disturbed during the first 24 hours of life

as this is when the calf must consume colostrum and the maternal bond forms. Disturbance around the pen will be minimized, by following the established feeding regime and only entering the pen at other times if necessary to visually check on an animal that cannot be observed from outside the pen or to capture a calf for collaring. Visual observation of every animal from outside the pen should be attempted before entering the pen and then only if there is no risk of disturbing a new cow-calf pair in the process. All radio collar frequencies should be listened to at least 2 times per day to check for mortality signals and collar function. The primary goals of staff are to ensure a quiet secure calving environment, while still monitoring all animals to ensure that appropriate assistance is provided if necessary.

3.3 VETERINARY CARE DURING CALVING

Most calvings are expected to be normal and not require intervention; however, a veterinarian will be available on site throughout the calving period. Visibility in the enclosure makes observation of calving very difficult, and it is unlikely that normal delivery of calves will be observed. If shepherds locate a calving cow, they should notify the veterinarian and all other staff on duty. Interactions with cows in labour should only occur if labour is not progressing or there is an obvious abnormality, according to Section: [3.4 Decision Tree for Intervention During Calving](#).

3.4 DECISION TREE FOR INTERVENTION DURING CALVING



3.5 CALVES

If collaring is required, calves will be handled only after 24 hours past birth (to reduce interference with cow-calf bonding and passive transfer of immunity), and within 48 -72 hours (maximum), to record sex and weight, collect hair for genetic analyses, assess condition, and attach an ear tag and lightweight, expandable VHF radio-collar (2017 & 2018) or proximity UHF/VHF collar (2014, 2015, & 2016). These collars are fitted with rot-off sections, allowing the collar to fall off within the next year.

Capture should not be attempted within 3 hours of darkness, near cows in active labour, near calves less than 24 hours old or when weather is excessively warm. Total handling time should be kept under 2.5 minutes, so procedures will be performed in order of priority (from most important - ear tag, sex, check umbilicus, collar, collect hair, weigh) with the least important only being performed if

time permits. Two to 3 handlers will be involved, with one person keeping track of time, recording information on the RCRW Calf Capture Form ([Appendix 13](#)), and watching the cow. One handler will perform a rapid physical examination, looking for any sign of injury, illness, or abnormality. If any are found the details will be recorded and, where possible, a photo taken. If the time taken to capture the calf (chase time) exceeds 5 minutes, the chase should cease and be attempted again after 6 hours or the following day. If the calf is not caught within 5 minutes on the second attempt, no further attempts will be made. The chase time and time it takes the cow and calf to re-unite after capture is recorded on the capture form. The calf is observed from a distance after capture until it has reunited with the cow. It is often difficult to observe the cow/calf pairs without disturbing them, and care should be taken to avoid hindering the process of re-uniting.

If neonatal calves show the following signs, consultation with the veterinarian should occur *immediately* and intervention may be required. Whenever possible, obtain a video:

- failure or difficulty to raise head or to stand, excessive shivering, weakness, incoordination,
- difficulty with or reduced number of nursing attempts,
- loose feces, changes in fecal colour or volume, straining to defecate or urinate
- discharge from eyes, nose, mouth, anus, prepuce/vulva,
- swollen navel,
- does not keep up with cow, behaviour appears abnormal, or
- vocalization
- the calf is considered to be orphaned/abandoned according to the following criteria: it has not stood to nurse within 2 hours and the cow leaves the calf or if the cow dies at birth. Abandoned/orphaned calves will be assessed by the veterinarian and if the criteria are met, removed from the enclosure, treated as required for support, fed with calf milk replacement by bottle or stomach tube or rehydrated with intravenous fluids, and transported to a captive facility for care, (i.e. Calgary Zoo) as per the Emergency Hand-Rearing of Orphaned Captive Caribou Calves protocol ([Appendix 14](#)).

3.6 Cows

Cows will be observed closely (with binoculars or spotting scope) at least twice daily in the week following calving since this is when health issues associated with calving are most likely to become apparent. Abnormalities to look for and report include membranes or discharge from the vulva, a swollen, reddened udder, weakness or lethargy, or any other non-specific signs of illness. Fetal membranes are usually delivered within two hours of birth and consumed or partially consumed by the cow. If delivery of the membranes does not occur within approximately 6 hours of birth of the calf, the membranes are considered 'retained' which should be reported to the veterinarian since intervention may be required.

The cow's udder is best viewed from behind. It is not particularly large when compared to domestic animals and it is abnormal if it appears very full or the cow refuses to let the calf nurse. Frequent checks and recording of observations informs early detection of health concerns and increases the chance of successful treatment. Health concerns of any kind, even subtle changes in behaviour or

body condition, should be reported immediately to the veterinarian or the veterinary team. Whenever possible, a photo or video should be taken.

If post-parturient cows show the following signs, consultation with the veterinary team should occur since intervention may be required:

- straining after calf delivery
- membranes or discharge from the vulva,
- distended, reddened or painful udder or not allowing the calf to nurse,
- cow is depressed and not moving normally
- not observed eating, including browsing, for several days,
- rapid loss of body condition,
- separated from the herd, increased or decreased activity, or not moving away from human presence,
- diarrhoea or fecal staining,
- coughing or rapid breathing,
- vocalization,
- other abnormal behaviours or postures

4. RELEASE FROM THE PEN

4.1 TIMING

Caribou cows and calves will be released in late June to mid-July, when the youngest calf is a minimum of 3 weeks old or when conditions in the pen are considered extreme (i.e. excessive heat). In the Little Smoky project, the youngest calf was 19 days old on release (Smith and Pittaway 2011), while in Chisana the caribou were released mid-June, when youngest calf was 10 days old (CCRT 2010). In 2014, the oldest RCRW calf was 8 weeks old while the youngest was just under 2 weeks old at release. In that year, 8 of 9 calves were born by mid-June but the 9th calf was not born until July 8. In 2015, cows and calves were released on June 13th. In 2016 they were released on July 17th and in 2017 on July 16 & 17. In 2018 all animals were released by mid-June due to unusually high temperatures (25 – 30 C) with the youngest calf only 8 days old.

4.2 PREDATORS

Prior to release, human patrols should be increased for several days, with activity and noise focussed away from the pen site. Patrollers will look for predators, scat, and foraging sign such as diggings in the area.

Cameras will be checked more frequently prior to release.

Discovery of predators in the area warrants the use aversion techniques (use of hounds), again, away from the site and delaying release by 48 hrs. If predators are detected during the 48-hour delay period, the 48-hour delay restarts.

4.3 RELEASE TECHNIQUE

Four to five days before release the feed troughs are moved close to the release gate along the north western flank to attract caribou to the area. Pelleted feed is gradually reduced during the period and small amounts of lichen are provided. Caribou are to be released as early in the morning as possible. The release gate or fence section is opened along the north western flank of the pen. Typically caribou will leave the pen on their own accord within several hours of the gate being opened. Troughs should be moved outside of the pen and lichen added to entice them out. Caribou should not be forced or pushed out of the pen. Ideally the caribou will leave together, as a herd.

Human presence at the release site should be limited to 1-2 people. They are to carefully record all animals that leave or re-enter the pen.

Once all caribou have left the area, the pen is thoroughly swept on foot (and with the telemetry receiver) to ensure no caribou are left in the pen and the gate is closed. Feed troughs are brought into the pen.

In the case that cows and calves are separated at release (and a calf remains in the pen), inform the veterinarian and leave the pen open during daylight hours. Cows may return for their calves >24 hours after release.

5. MONITORING AFTER RELEASE

The satellite GPS collars used from 2014-16 provided researchers with daily emails on cow location, mortality status and calf status. Fixed-wing telemetry flights are needed occasionally to confirm that the VHF transmitters are working. The calf collars are expandable VHF/UHF proximity collars (VECTRONIC Aerospace) with signals that were picked up by adult collars and transmitted via satellite. In 2017 and 2018, calves collared were fitted with a standard VHF expandable collar (Advanced Telemetry Systems Model M4210) that did not communicate with the adult collars. Calf statuses for those years were monitored during flights using a VHF receiver.

Aerial surveys are performed each March in conjunction with the provincial census. Marked cows are observed and calf collar frequencies are scanned to determine if they still have a calf at heel. Calf survival will be calculated using the binomial estimator (Murray 2006), which is the number of marked calves observed during census divided by the number born the previous June in the pen. This metric is also tracked throughout the year (i.e. prior to the March survey), using the collars or flights as necessary. These survival rates are compared to estimated wild calf survival rates, based on recruitment data from this system from 1992 – 2013 (Wittmer et al. 2005b).

Near real-time tracking from the satellite collars provides movements of penned animals to traditional summer and fall habitats in the area (sensu Apps et al. 2001). All mortality signals are investigated as soon as possible to determine cause of death. In the event of a mortality, at least 2 researchers will access the site as soon as possible and will use the standard mortality investigation protocols ([Appendix 12](#)) provided by the B.C. Caribou Recovery Program and Wildlife Health

Program. The protocol provides detailed forms outlining procedures, sampling methods, required equipment and standards for site investigations.

At a minimum those investigating mortalities should take photographs/video, make extensive notes, observe caribou and predator tracks, scat, hair and tooth marks, and look for evidence of other mortality causes (avalanche, falls, vehicle collisions, etc.) and assess potential pre-disposing factors (broken bones, worn teeth, poor body condition, lack of marrow fat, etc.). For cows, the area should also be searched for the calf collar and remains.

6. PREDATORS

One of the project's goals is to prevent predation (i.e. have no predators enter the pen with no lethal removal required). Predators that occur in the area are wolves, grizzly bear, black bear, cougar, lynx, wolverine, and eagles. Protecting the caribou includes preventing the approach of predators through human presence, early detection of animals, and mitigation of persistent animals. Lethal removal of persistent predators may be required as a last resort, but primary mitigation measures include a strong electric fence, physical barrier, consistent surveillance, aversive conditioning, and detection using motion-activated cameras at the fence and surrounding roads. Wide area sweeps will be conducted to ensure that there are no predator attractants in the area prior to caribou introduction and during the penning period.

All of the above predator species have been recorded by remotely triggered cameras within a few hundred meters of the pen, but most did not approach the pen closely, and none entered the pen during 5 years of operation. Black bears walked the fence line in all years. Shortly after caribou introduction in 2014, a wolverine was observed attempting to access the space between the pen wall and the electric fence but did not enter, presumably because it received an electric shock. A few days later, a moose cow and calf mortality site was found in close proximity. These carcasses were promptly removed from the area. The wolverine did not return in 2014. In 2015, a wolverine was remotely photographed at the release gate but did not try to enter the pen. Wolves have not been remotely photographed directly at the pen but were recorded by other cameras within 150m of the pen in most years. In 2016, a cougar was photographed walking the fence perimeter on several occasions and crouching at the bottom of the fence. In 2017, a cougar as well as a grizzly with 2 yearling cubs were remotely photographed at the south western corner. There was no evidence of pen entry attempts. In 2017, early in the morning of the proposed release day, a cougar was remotely photographed at the south western corner, so release was delayed. In 2018, the site was visited by grizzly bears, black bears and a wolverine. Over the 4 years of the Chisana project, one black bear entered the pen and was killed, while 8 grizzlies and 1 wolf were successfully deterred.

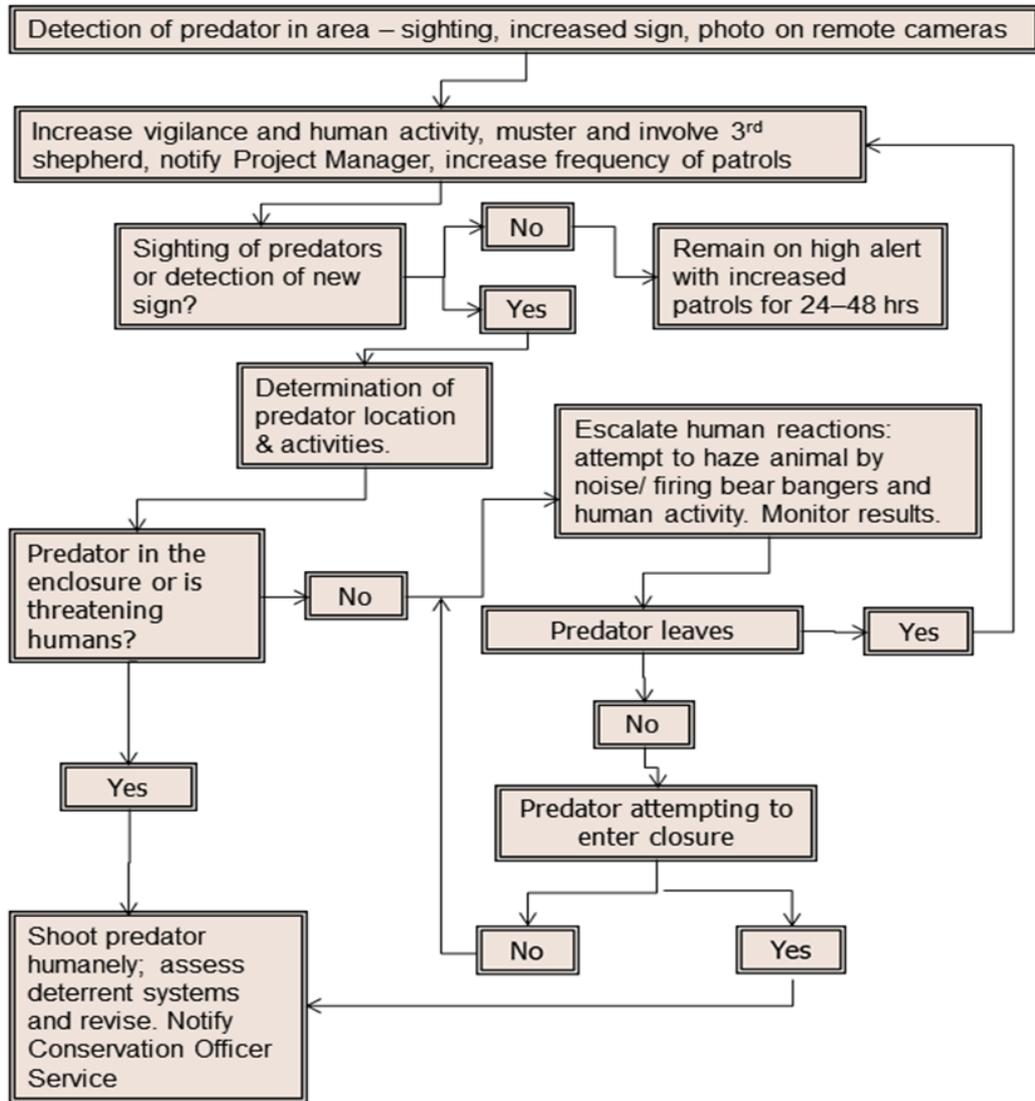
The pen was constructed to provide a visual and physical barrier and includes set back electric fencing to provide further deterrence minimizing the risk of predators entering the pen. Should predators be detected near or at the pen, intervention will follow protocols as outlined in Section: 6.1 Decision tree for response to predators

Specific details regarding protocols associated with predators include:

- Staff will perform pen perimeter patrols and road walks, several hundred meters up each access road at least 1-2 times per day, except if there are concerns regarding potential caribou disturbance (i.e. calving),

- shepherds will be encouraged to hike a larger radius around the enclosure to increase the zone of human activity,
- remote cameras will be placed on access roads to monitor wildlife in the area. Cameras will be checked every two days. In 2017, three “Buckeye®” remote cameras were installed that instantly relayed photos to the project laptop computer in the shepherd’s cabin. The remote cameras are strategically located at the Lake Trail (approx. 150m N of the Release Gate), at the Release Gate and at the SW Corner,
- if a predator approaches, human activity and noise will be increased in the vicinity of the predator,
- shepherds' actions will follow the predator decision tree below. All shepherds will have training with firearms and deterrent techniques and have experience using their professional judgement to responsibly manage threats from predators. In general, the level of action against a predator will increase if the predator shows no sign of being deterred. Deterrent actions will progress from human noise and non-lethal methods such as bear bangers, rubber bullets, to lethal methods if necessary (i.e. predator attempts to get into the pen or is overly aggressive towards shepherds), and
- all observations of predators, all encounters, and any actions taken, will be recorded in a Daily Shepherd Log ([Appendix 8](#)). Escalating concerns about predators that require active deterrence measures will be reported immediately to the board operations committee and the Conservation Officer Service.

6.1 DECISION TREE FOR RESPONSE TO PREDATORS



7. FOREST FIRE

The South East Fire Centre, along with local fire managers, have been provided with an exact location of the pen, and it is established that the surrounding area is a top priority for fire suppression.

In the unlikely event of a fire near the enclosure, pen staff will:

1. Report the fire by phone by calling 1 800 663-5555 **as soon as possible** and provide the following information regarding the fire:
 - Location (inform them you are calling from the RCRW caribou pen)
 - Size of fire
 - Rate of spread
 - Fuel type that burning (grass, bushes, trees, etc.)
 - Smoke/flames (color, visible or not)
 - Threat (its is imperative that they're informed of the level of risk to the pen)
 - Action (any current actions being taken to fight the fire)
2. Take appropriate action to release caribou and ensure human safety, if the fire threatens the life of caribou or staff.

8. ENCLOSURE DETAILS AND MAINTENANCE

The RCRW pen was constructed in a sparsely restocked clearcut at 580 m elevation, adjacent to Lake Revelstoke in typical early winter range of the Columbia North caribou subpopulation. The initial size of the pen as built in the fall of 2013 was 6.4 ha. In the fall of 2015, the pen was expanded to 9.3 ha to include an adjacent stand of mature forest which provides conditions more typical of those used by mountain caribou while reducing rearing densities. Caribou typically calve in this region at and above treeline (approximately 1700m). The pen is comprised of non-woven ARMTEC 300 geotextile, measuring 4.57 m high suspended from a 1 cm diameter galvanized wire rope supported approximately every 3-7 m by 10 cm diameter by 6 m long hollow metal posts (used drilling pipe) vibrated 2 m into the ground. The effective height of the fence is approximately 4 m with 0.5m serving as a ground level skirt laid toward the inside and the remaining draped over the 1 cm diameter wire rope and sewn to itself with UV resistant cable ties spaced approximately 1 m apart. One main blind and six tree stands are located around the pen to observe the caribou. Two of them provide clear views of the feeding troughs and two with clear views of watering stations.

A 2.4.m high electric fence surrounds the entire pen. It's supported by metal outriggers attached to the geotextile wall posts. The fence is powered by a 110 V AC Parmak RM-1 charger with a 16,000 V output capability. The system uses high tensile solid aluminum wire, rather than the more common braided poly-wire, as it provides a physical barrier and requires less maintenance. The fence has a total of eight hot wires interspersed by six ground wires. Hot wires are those that pass through insulators while ground wires are attached directly to the outriggers which are in turn grounded by the metal posts. The electric fence is controlled from a central panel adjacent to the main pen

entrance that allows various levels or “banks” of hot wires to be electrified as snow gradually melts and exposes them. In addition to a master switch, there are 5 additional switches that activate the individual banks of hot wires. Switch 1 activates the top 4 hot wires, all of which must be exposed and activated prior to capture in late March. Switches 2 to 5 each activate one of the 4 remaining hot wires moving down the fence. Considerable snow (2-3 m) is present in and around the pen from capture until approximately early May. Since it melts unevenly within and around the pen individual banks of electric fence wires cannot be turned on until the entire length of every hot wire within each bank is completely free of snow. This can create a vulnerable situation along the south flank if all of the wires are exposed there but are still under snow elsewhere. In this case, a spool of braided poly electric fence wire is used to add a lower temporary wire (secured to a higher electrified hot wire) if the snow has melted significantly below the lowest electrified hot wire.

Staff must check the geotextile pen wall and electric fence at least once daily to ensure:

- there is adequate voltage. Acceptable voltages range from as high as 8000 V when only the top bank (4 hot wires) is activated to as low as 5000 V when all 5 banks are activated. Voltages less than indicated suggest short circuiting likely due to vegetation contact or broken insulators,
- vegetation is not contacting any of the electrified hot wires. This grounds the system and draws power which can result in power failure if left unchecked. Geotextile approx. 1 m wide is located on the ground under the lowest wire to reduce vegetation growth but attention is still required along its edge,
- insulators on hot wires are in good condition. Check for any damage including hairline cracks. Turn off the main supply switch and replace all insulators that are broken or bent. Inspect cable guides for the ground wires and replace any that are broken or missing,
- there are no loose electric fence wires. Loose wires need to be tightened by turning the nearest tensioning wheels. Fence wires need to be tight,
- there are no cracks in fence support posts or excessive bends. Report any deficiencies,
- geotextile is not coming into contact with the electric fence. Repair or tighten geotextile as needed,
- there are no sags or separations in main support cable. Re-tension any separations with the come along and cable grips, adding a section of cable if necessary. Use only Crosby® brand cable clamps,
- the fence wall has no tears or rips. Sew and cover all rips or areas showing signs of wear using geotextile and cable ties,
- there are no broken cable ties. Replace all ties that are broken or missing.

The solar powered watering system consists of an array of ten solar panels that power a Grundfos 11SQF-2 submersible well pump located adjacent to Lake Revelstoke approximately 50 m from the pens SE corner. The solar panels are mounted on a tilting wood support frame that can be angled to the optimal seasonal solar position; however, the structure cannot rotate and is fixed in a due south aspect. The well pump is suspended off a log that extends from the shoreline approximately 15 m into the reservoir. The pump supplies a 1.5” ABS potable water line that runs along the eastern flank

of the pen, supplying water to three individual stations. The three stations each have two water troughs made from 20 cm diameter by 7 m long PVC potable water pipe with $\frac{1}{8}$ of the circumference removed and inlet and outlet fixtures added. The first station (“SE Station”) is located at the southeast corner and has two troughs in parallel. The second station (“Palace Station”) is located at the highest point along the east flank approximately 50 m south of the main blind in has two troughs in series. The third station (“N Station”) troughs are also in series and are located approximately 100 m north of the main blind. Valves control the inlet water flow at each station while outlet water is drained outside of the pen to prevent pooling. Under optimal conditions during the penning period (full sun at noon on the summer solstice with the panels tilted 55-60° from vertical) the system provides a total of 45 litres/min of water at the highest point along the line. The water supply system is not designed to operate under pressure so at least one of the stations valves must always remain fully open. If not, the system will pressurize and the hose clamp connections on the system will fail. For best operational flexibility the Palace Station inlet valve is always left fully open while the valves at the other two stations are partially closed until there is approximately an equal amount of water being supplied to each station. Two check valves on the main supply line outside of the pen prevent the system from draining when water is not being pumped. Water depth in the troughs is controlled by standpipes at the outlet ends. The standpipes ensure enough water is available throughout the night while the solar powered pump is not operating. To assist with removal of sediment and debris the standpipes can be temporarily removed.

Staff must check the watering system at least once daily to ensure:

- the well pump is operating (during daylight hours),
- all water supply and trough drain line connections are intact and are not leaking
- each station is receiving approximately 1/3 of the available flow
- the troughs are draining freely
- the troughs are clean of sediments and debris

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10. APPENDICES (HYPER LINKS)

[Appendix 1 - Final 2018 Capture Manual March 26, 2018 FOI Version](#)

[Appendix 2 - RCRW Capture Safe Work Procedures - March 19, 2018](#)

[Appendix 3 - Maternity Penning Caribou Drug Protocol 2017](#)

[Appendix 4 - BC Caribou Maternity Penning Data Form - 2018 - V1.0](#)

[Appendix 5 - RCRW Lichen Collection, Handling, Storage & Feeding Handbook](#)

[Appendix 6 - Unifeed 15% Caribou Pellets - Feed tag code 19-3702](#)

[Appendix 7 - Calgary Zoo Winter Herbivore Pellets - Formulae code M800710](#)

[Appendix 8 - Daily Shepherd Log](#)

[Appendix 9 - Individual Daily Observation Record](#)

[Appendix 10 - Caribou Body Condition Score Chart](#)

[Appendix 11 - Caribou Illness Reference Card](#)

[Appendix 12 - BC Caribou Research Program - Mortality Site Investigation Form](#)

[Appendix 13 - RCRW Calf Capture Form](#)

[Appendix 14 - Emergency Hand-Rearing of Orphaned Captive Caribou Calves](#)