

Preliminary Fencing Report

Exits 17 to 18 - Highway 107, Nova Scotia

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Final Version 3

Prepared for:

Nova Scotia Public Works

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1.0 Introduction

This document makes recommendations for installing wildlife fencing and jump outs for the eastern portion of the study corridor of Highway 107 between Exits 17 (Preston's) and 18 (Mineville). Nova Scotia Department of Public Works (NSPW) is considering fencing a portion of this corridor in 2023, the remaining portion in the future. This document provides recommendations for how partial fencing and escape measures in the eastern portion of the corridor could be effectively placed without inadvertently increasing risk of wildlife/vehicle conflict. This document further presents options for complete fencing and wildlife crossing locations for the remaining western section of highway.

In selecting initial fencing and escape measure placement, it has been assumed that a small mammal terrestrial ledge and a large mammal terrestrial corridor will be retrofitted at the Partridge River bridge crossing as previously proposed. It is assumed that fencing placement will facilitate access to all existing culverts by small/medium mammals that may use them to cross under Highway 107.

Throughout this document Small mammals are considered rabbits, porcupine, raccoon, skunk, muskrat, beaver, and domestic cats that have been observed along the study corridor; although others species are undoubtedly present. Medium sized mammals are considered coyotes, and Large mammals are considered deer. Black bear may also be present in the area. Although no observations or locational data confirm their presence along the highway corridor, they have been noted in incident reports by the public in the rural residential areas north and south of the studied highway corridor. The size categories referenced are generalizations and should not be considered exclusive of any native Nova Scotia fauna.

2.0 Assessment of Wildlife Movements

Excluding wildlife from crossing the ~4.3km section of Highway between Exits 17 and 18 through installation of wildlife fencing is desired for the protection of the travelling public and to reduce the impact to wildlife populations in the area. However, it is important to maintain wildlife habitat connectivity north and south of Highway 107. The largest contiguous wildlife habitat north of the study area is section 1N, while the largest south of the Highway 107 is 3S as shown in Figure 1. Although large mammals likely move between all identified habitat areas it is anticipated that maintaining connection between the two largest land tracts, 1N and 3S, is important. As small mammals have smaller home ranges, maintaining connections between habitats supporting these species is required at a smaller spatial scale. Risks of human injury resulting from vehicle/wildlife conflict is generally considered lower for small mammals, while accidents with or caused by medium and large mammals pose greater risk of human injury and damage.

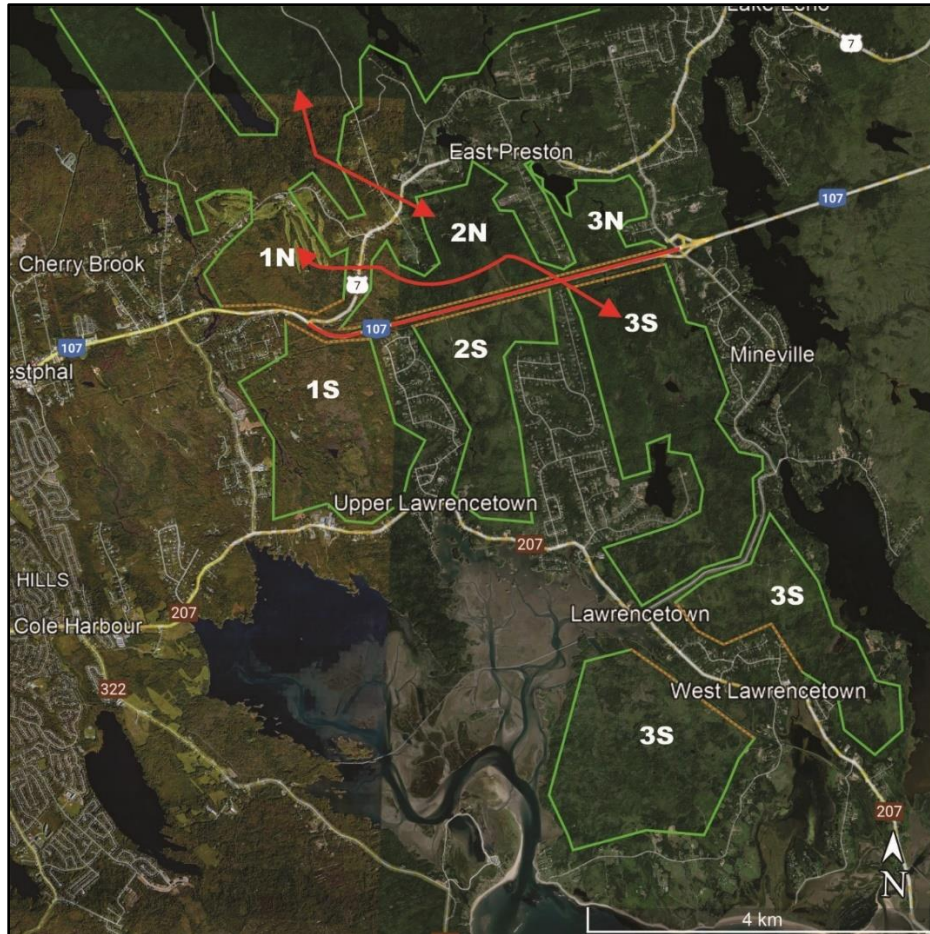


Figure 1: Preliminary assessment of large habitat areas north and south of the Highway 107 project site. 1N and 3S are the largest land areas and it is anticipated that large mammals would attempt to connect these areas during seasonal movements. The red arrows do not reflect actual crossing areas, only anticipated general movements connecting large habitats. Local scale movements could vary considerably.

During 2022 two winter walks (February 17th and March 01st) were conducted to document wildlife tracks and signs along the Highway 107 study corridor; wildlife cameras were established at three locations over the period of April 13th to May 22nd to capture wildlife movements at anticipated areas of use; and road kill surveys were conducted on the winter walk dates as well as April 28th, May 12th, August 24th and November 15th. This data, along with the location of large (deer) and medium (coyote) mammal track observations made during a winter walk of the corridor by Stantec Consulting¹ on December 17th, 2020 are presented in Figure 2. Although additional data collected by DPW, NS DNRR and RCMP was considered (Bear, deer and moose BIR data files, RCMP Animal Collision data, Highway 107 Burnside to Trunk 7 Road Safety Review (2018)), the spatial accuracy of these data did not inform placement of wildlife fencing/crossings. Locational documentation of these data sets was generally accurate within ~2 to 5+km or was based on public observations in residential areas and hunter activity which were both located away from the highway corridor. To help inform the placement of wildlife fencing and crossings an accuracy of wildlife observations is needed at approximately $\pm 100\text{m}$ or less. This requirement makes site specific field surveys the most appropriate data source for wildlife planning along Nova Scotia's highways. Winter track surveys have the added benefit of helping determine actual crossings, and direction of crossing of the highway corridor.

¹ Stantec Consulting Ltd. 2021. Highway 107 Wildlife Underpass Evaluation and Site Selection. File 121416882. July 8, 2021. 40pp.

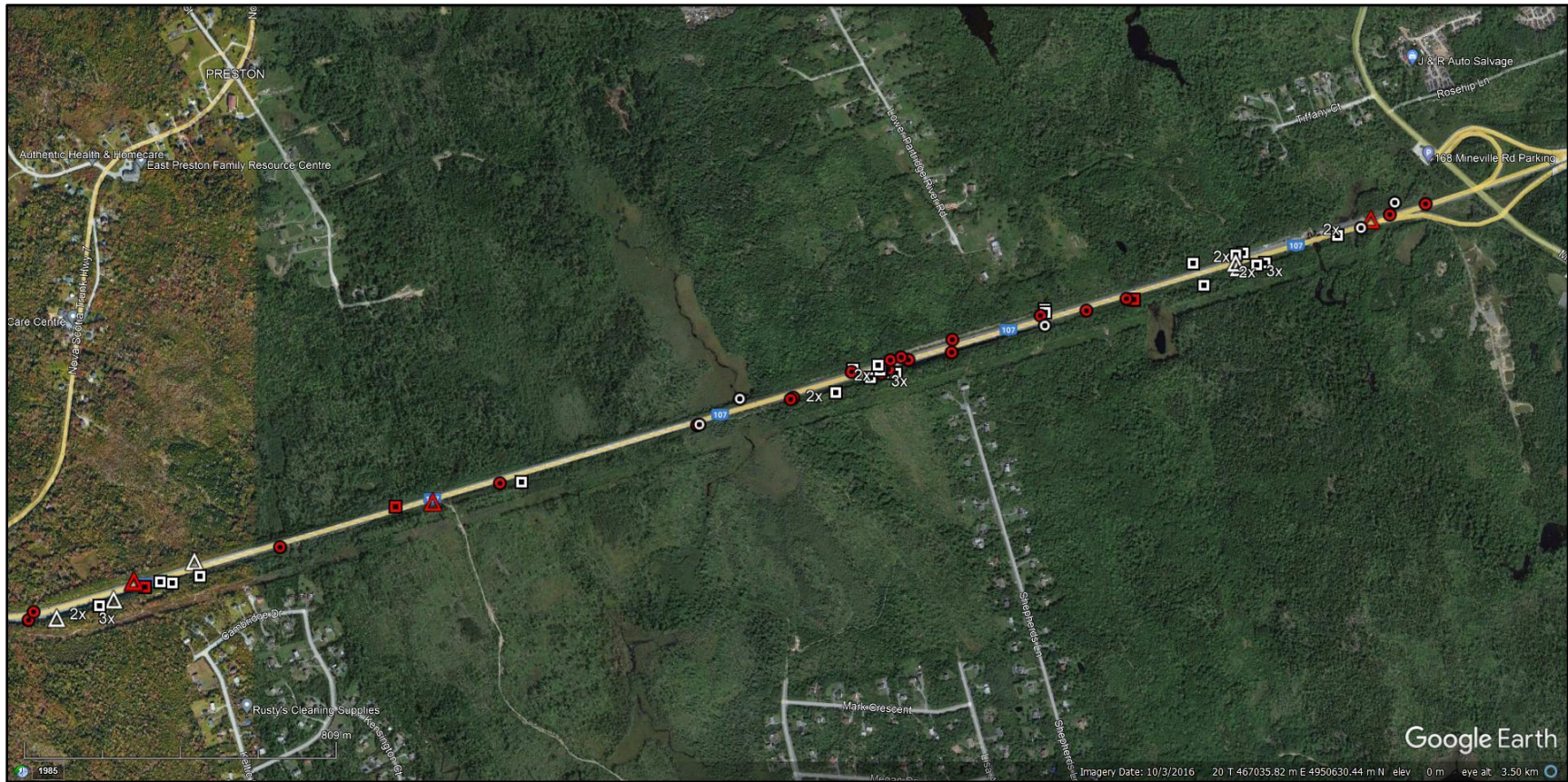


Figure 2: Observation (white symbols) and road kill (red symbols) location of wildlife in 2022 along the project corridor. Small mammals (circles) were the most numerous documented roadkill while medium-sized mammals (squares=coyotes) were both the most numerous observed and observed actively crossing the highway. Large mammals (triangles) are represented only by deer, although other large mammals may be present in the study area.

Table 1 summarizes all wildlife observation and road kill data collected in 2022 and depicted in Figure 2. It shows that small-sized wildlife were more frequently killed along the Highway 107 study area. Spatially, the greatest number of small animal kills occurred in and around an area of highway bordered by rock cut. This area is also at a crest in the highway and line of sight visibility may be poor for drivers. The rock cut would prevent easy escape from the highway corridor and the short line of sight would increase the risk of vehicle/wildlife collision. Medium sized mammals, represented only by coyote in the data set, were the most numerous observed along the corridor. Medium and large mammals are more likely to cause significant damage and pose greater risk to the driving public when encountered. Seven dead animals from these two size categories were located in 2022 despite a relatively limited number of roadkill survey dates (5). These carcasses were observed to be persistent in the highway corridor for a period of weeks to months.

Table 1: Summary of study wildlife observations and road kills along Highway 107 in 2022. Observations are of tracks, scat, or wildlife camera photos believed to be from a single animal.

	Total Observed or Killed	Observed* (#/% of total Obs.)	Killed (#/% of total Obs.)	Animals Represented
Small	25	6 / 13%	19 / 73%	Porcupine, crow, rabbit, racoon, muskrat, domestic cat
Medium	33	31 / 69%	3 / 12%	Coyote
Large	12	8 / 18	4 / 15%	Deer

As indicated in Figure 3, large/medium sized mammals appear to currently be using two confirmed (CR1, CR2) areas and two additional possible (CR3, CR4) crossing locations along the project Highway 107 corridor to maintain connectivity between habitats north and south of the highway. The identification of these crossings is based on concentrations of data from the roadkill, winter track, and wildlife camera information collected to date. Confirmed crossings were locations where winter track surveys confirmed species and direction of movement at a single location on either side of the highway on a given date. Possible crossing activity is inferred by a concentration in observations in an area, but no confirmed track movements across the highway corridor on a given date.

As shown in Figures 3 and 4, when real (vertical bedrock cut) and perceived (guardrails, private fencing, steep embankments) barriers to wildlife movement are considered, all four locations of large/medium mammal crossings align with limited barriers connecting larger areas of habitat north and south of the highway. Also of note is that road kills of medium and large mammals did not occur in the central portion of the survey area. This is a section of highway where topography and highway straightness generally provide a long line of sight for drivers. There is a section where a road crest within the rock cut may limit line of sight, particularly for east bound drivers. However, it is expected that medium and large mammals do not enter the highway corridor through the rock cut, and area with no tracks, but instead stay atop the rock cut as evidenced by numerous tracks. Most medium/large mammal roadkill (5) were located near CR 3 and 4 where eastbound traffic rounds a corner over a crest of a hill and speed limits increase, factors that reduce line of sight and reaction time for drivers.

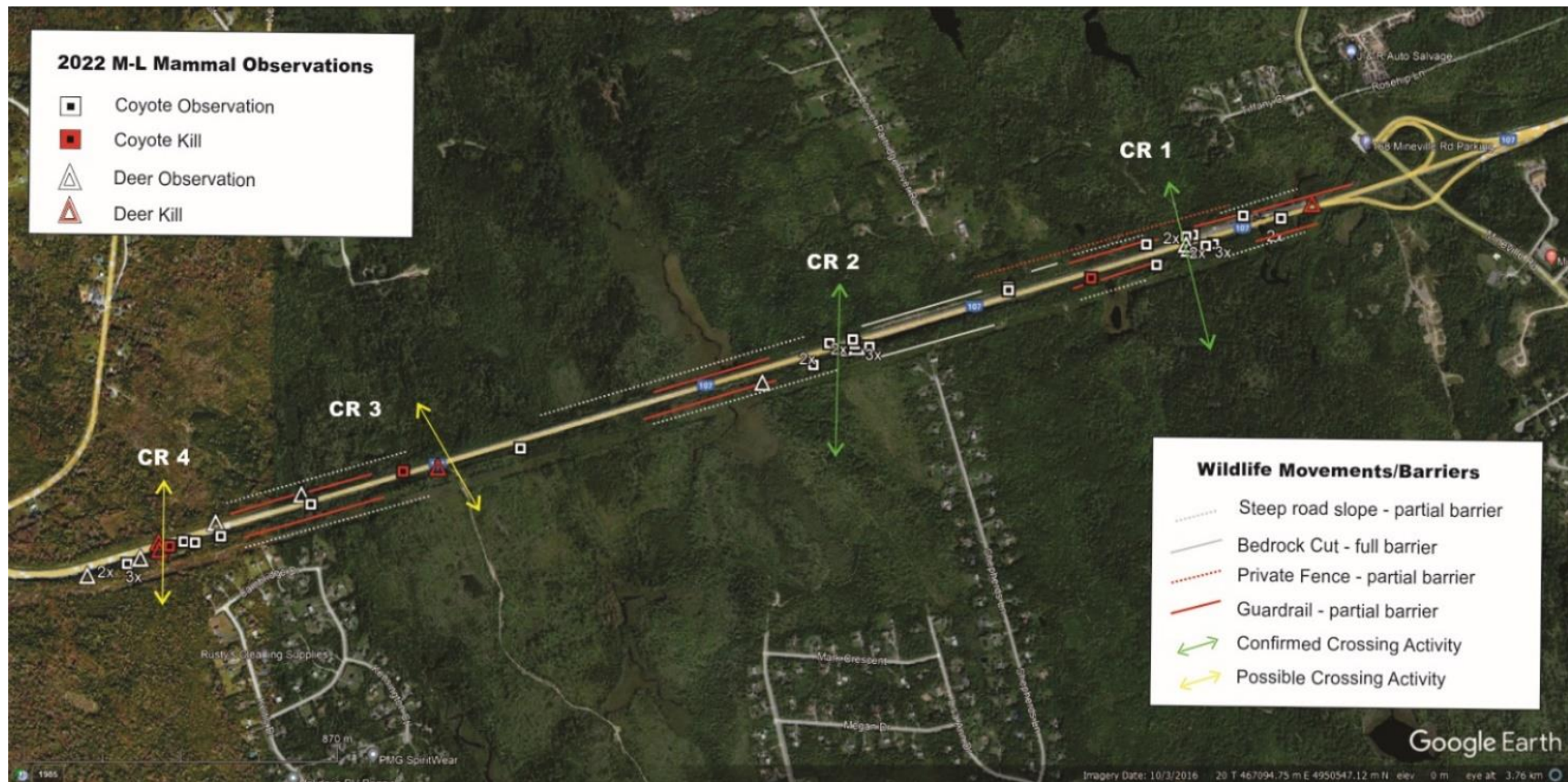


Figure 3: The locations of observed (white symbols) and road killed (red symbols) medium and large animals along the Highway 107 project corridor align with general gaps in the identified full and partial barriers to their movements. Confirmed crossings are where winter track surveys confirmed species and direction of movement on both sides of the highway. Possible crossing activity is inferred by a concentration in observations but no confirmed track movements across the highway. Road kills of medium (squares) and large-sized mammals (triangles) did not occur in the central portion of the survey area where topography and highway straightness generally provide a longer line of sight for drivers.



Figure 4: Current (2022) perceived full and partial barriers to wildlife movement across the Highway 107 study corridor are indicated. Current confirmed and potential wildlife movement corridors across the highway (CR#) generally occur where barrier gaps exist.

It is important to understand that wildlife's current crossing locations of a highway reflect the location of current barriers to movement and available habitats but not necessarily where animals would have historically moved or would preferentially move if human development did not exist. Animals generally follow low elevations in the landscape (along rivers and drainages) and high ridges. Along the study area the primary drainages along Robinson Brook and Partridge River as well as the top of the ridge through which the Highway 107 rock cut occurs likely would have been wildlife movement corridors historically. Easy movement for wildlife along these areas does not exist today because of the 10m deep rock cut through the ridge and the steeply elevated prism and guardrails over the watercourses, as shown in Figure 4. Therefore, the medium and large mammals have likely shifted movements over time to the locations with fewer barriers observed those areas (C1- C4) currently used. When selecting a location to establish wildlife crossings of a highway both the current and historically preferred wildlife movement corridors should be considered. The anticipated retrofit of the Partridge River bridge as a terrestrial wildlife crossing aligns with both historic and a nearby current (CR1) crossing location. Challenges and opportunities exist with all the remaining current (CR2-3) and historic locations. However, site recommendations are made in the final section of this report for a second large mammal crossing to be constructed in the future along the Highway 107 study corridor based on wildlife observations.

3.0 Fencing/Escape Measures Design

NSPW has requested design of a partial fencing plan with escape measures that could serve as initial steps to be implemented in 2023 to reduce the risk of vehicle/wildlife collisions. It is further desired that the initial design consider wildlife habitat connectivity and minimize the potential of significantly disrupting movement of wildlife across the highway corridor. Based on these requirements and the assessment conducted to date it is proposed that partial fencing and installation of escape measures could be effectively installed on the eastern portion of the Highway 107 corridor between Exits 17 and 18.

Currently, proposals are under review for a small/medium mammal terrestrial ledge retrofit to the east side of the Partridge River bridge abutment and a large mammal terrestrial crossing retrofit to the west side of this underpass. The approval of these structures will make it feasible to fence the east end of the assessed highway corridor without potentially adverse effects to wildlife movement. Fencing mesh should not be installed until the retrofitted wildlife crossing at Partridge River is established, although posts and escape measures (jump-outs) could be installed at any time.

Within this document the highway corridor side of the wildlife fencing is referred to as the “highway side” while the area outside of the fencing is referred to as the “safe side”, reflecting that it is safe for wildlife to be outside of the fenced highway corridor.

3.1 Fence Alignment Requirements

Wildlife fencing must have an effective height of 2.4m as measured from the ground 2m away from the fence on the safe side of the fencing to prevent White tailed deer from jumping over the fence. Fencing is to be buried 0.1m+ at the bottom or pinned down as a wide skirt to discourage digging (NSDLF 2019) by wildlife and to maintain integrity from other disturbance to the fence. The buried portion, or any portion needed to eliminate a gap at the bottom due to a dip in the terrain, must not take away from the overall 2.4m effective height of the fence. Fencing must have a smaller mesh size near the bottom to both contain small animals from passing through the fence and to inhibit the ability of bears gaining a foothold to climb over the fence. The bottom 0.8m in height (measured from the *ground* at the base of the fence and *not* including the buried apron portion) of the fencing must have the smaller panel sized mesh. Within the bottom 0.8m of fence the *largest* mesh opening dimension (typically diagonal between corners of a square or rectangle mesh) must be <10cm. For the remaining fence portion between 0.8m and 2.4m+ above ground the fence mesh size must not exceed 15cm in the largest vertical and horizontal dimension. It may be smaller, but must not be larger than this dimension to ensure medium to large mammals are excluded from the highway corridor. The following outlines site considerations to achieve the prescribed fencing requirements.

Wildlife fencing is likely to have ongoing maintenance requirements and without a commitment to regular and timely maintenance of fencing eventual structure failure could lead to increased risk of vehicle/wildlife collision. This would occur if a section of fence fails and allows wildlife to enter the fenced highway corridor where they then become trapped within a relatively narrow and heavily travelled section of highway; leading to a high probability of collision. To minimize the likelihood of fence failures, wildlife collisions, and maintenance requirements several alignment details need to be considered during installation and regular monitoring must be made of all structures.

First, wind storms that result in tree blow down can cause significant fence damage if fencing is located close to the forested edge of the ROW. Therefore, installation of fencing in the ROW at a location where the risk of wind fall tree damage is minimized should be considered.

Second, highway snow removal can cause fence damage. Therefore, installation of fencing in the ROW at a location beyond the reach of the snow plow “throw zone” is necessary.

Third, human activity in the highway corridor can lead to fence damage. This may be from vehicular accidents or individuals seeking OHV/walking access. Therefore, the specific installation location of new fencing in the ROW should consider risk factors from existing human activities and known areas of greater vehicular accidents.

Fourth, fencing across watercourses/drainages has an increased potential to allow wildlife penetration into the highway corridor and to create maintenance impacts. Avoiding placement of a fence across a watercourse eliminates the risk of flood/ice/debris jam damage to the fence. To allow for both unimpeded water drainage and to facilitate potential for small mammal use of culverted water crossings under the highway, wildlife fencing must cross over the top of a culvert between the culvert end and the edge of the highway as shown in Figure 5. If a water course is wide (>2m) or deep (>0.5m) a terrestrial area between the head of a culvert and the fencing of ~2m should be maintained such that wildlife can avoid the stream by moving over the head of the culvert. In some instances with older culvert installations, the proximity of the fencing to the highway to pass over the head of the culvert may require placement of a guardrail between the fence the highway. Although it is not an issue at the Highway 107 study site it is noted that the entrance to culverts that drain the median of a divided highway or off ramp area must not be fenced over the head of the culvert, but rather across the watercourse/drainage from the culvert. Allowing animals to freely access these culverts mean they can gain entry directly to the fenced highway corridor where a wildlife/vehicle collision becomes a high probability.



Figure 5: Wildlife fencing must be placed between the head of culverts and the highway to allow potential for small mammal use of the culvert as passage under the highway and to minimize fence maintenance requirements associated with water and debris.

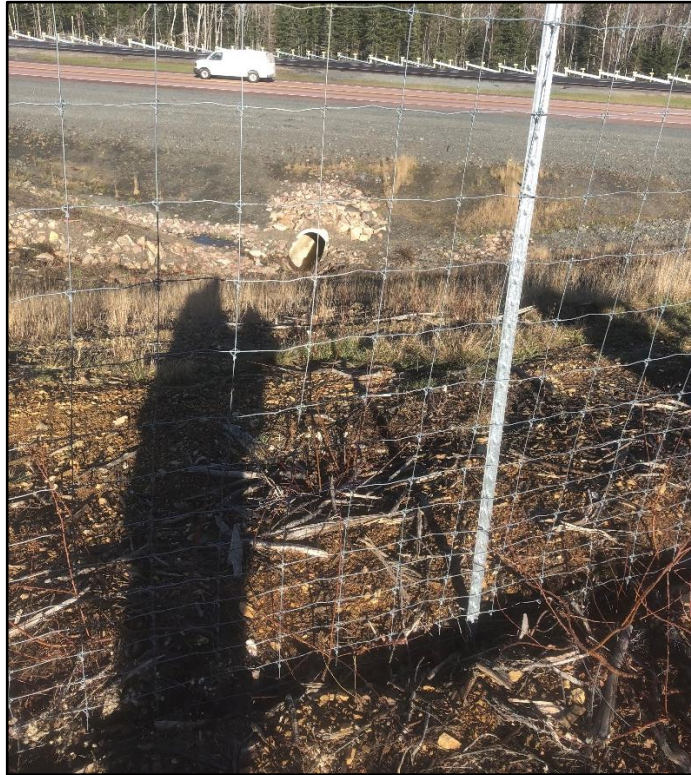


Figure 6: When fencing is not installed between the head of a culvert and the highway, as has occurred in this case, small/medium mammals can not access the culvert entrance as means of crossing under the highway.

Fourth, gaps between fencing and existing structures can provide opportunity for wildlife to access the highway corridor if they are not minimized. This occurs because animals will tend to move along a fence seeking a means of getting around it, particularly with new fencing when wildlife are not familiar with available movement corridors. Therefore, close attention must be paid to ensuring no gaps exist where fencing connects to the Partridge River bridge abutments, the rock cut in the central section of the assessed corridor, escape measure structures, or any other existing structures should they be incorporated into the final fencing alignment.

Fifth, gaps under a fence can easily allow small and large mammals access to the highway corridor. Gaps may exist from incorrect installation over dips in terrain, erosion under a fence, or some physical damage to a section of fence. Monitoring must be incorporated to ensure these conditions do not occur. Fencing is to be buried 0.1m+ at the bottom or pinned down as a wide skirt (NSDLF 2019) to discourage digging by wildlife and to maintain integrity from other disturbance to the fence. The skirt or any buried portion or portion used to eliminate a bottom gap may not take away from the overall effective 2.4m height of the fence nor from the 0.8m above ground small mesh panel requirement.



Figure 7: Gaps under a fence at drainages and dips in the terrain can easily allow even large mammals to gain access to the fenced highway corridor where the probability of wildlife/vehicle collision is high. An extension of the fence bottom is required to minimize the gap. A flexible apron could be wired to the bottom of the fence in this image to limit wildlife access while minimizing potential maintenance from stream debris. Ongoing monitoring is required to ensure proper function.

Sixth, the wildlife fence must achieve an *effective height* of 2.4m as measured 2m from the safe side of the fence and based on chosen final alignment this objective will require an actual fence height well in excess of 2.4m. White tailed deer will rarely jump a 2.4m high fence. Two meters away from the fence is approximately where a deer would initiate a jump attempt over the fence. If the fence is placed on a slope where the safe side of the fence is higher than where the fence is installed the fence is effectively shortened as shown in Figures 8 and 9. This provides opportunity for deer to jump over a fence that is 2.4m of actual height. In such cases, additional height must be added to the fence to achieve the effective height of 2.4m. Avoiding placement of the fence on sloped areas, if possible, will eliminate the need to modify the actual fence height. At two meters upslope from the fence on a 2:1 slope 1m of effective height is lost and a 3.4m high fence would be required. At two meters upslope from the fence on a 3:1 side slope 0.70m of effective height is lost and a 3.1m high fence would be required. In both of these examples fence posts and fencing will need to be taller than 2.4m above ground in order to achieve an effective height of 2.4m. However, careful siting of the fence installation will avoid many challenges with achieving an effective 2.4m fence height.

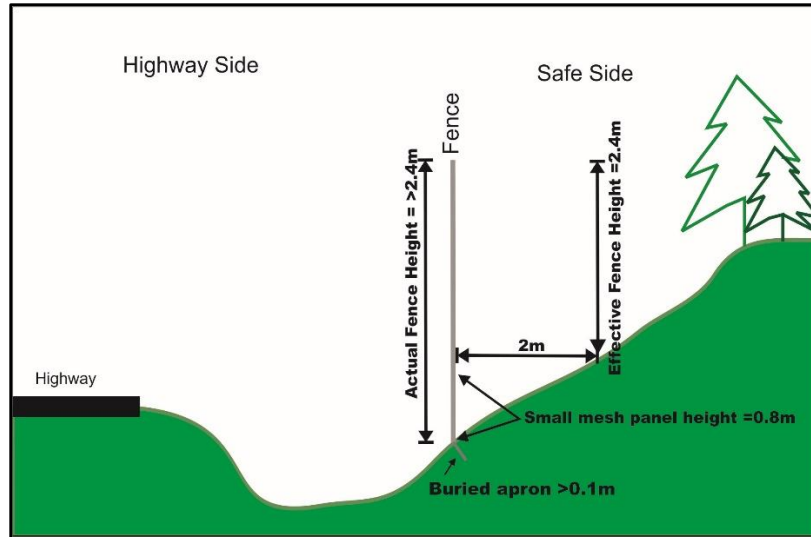


Figure 8: Effective fence height is measured from the ground 2m away the safe side of the fence and must be 2.4m. If the ground has a higher elevation on the safe side the actual fence height will need to be >2.4m to achieve an effective height of 2.4m.

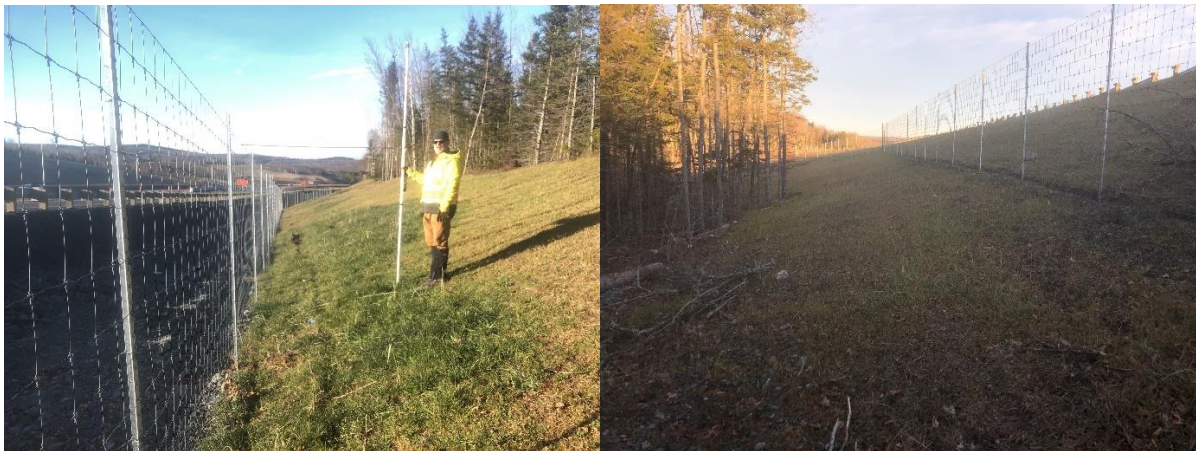


Figure 9: The effective height, as measured 2m away from the fence to accommodate for where a deer is likely to initiate a jump, is considerably less than the actual 2.4m height of fencing when the safe side of the fence is higher than the highway side (image left) while the effective height becomes greater than the actual fence height when the safe side is lower than the highway corridor (image right). Modifications to the fence in the left image will be required to prevent deer from jumping into the highway corridor.

To allow installers to address the site specific conditions that arise along a fence line it is recommended that a fence product height that is at least 3.1m that has a smaller mesh size over at least the bottom third be used. It may still be necessary to add additional material to close bottom gaps, or extend the height in some site locations.

3.2 Highway 107 Initial Fencing Area

Fencing could be installed from Exit 18 at Mineville westward to a large wetland area and ending at the east branch of Robinson Brook as shown in Figure 10. Fencing must be installed on both the north and south sides of the road at the same time to prevent capture of wildlife within the highway corridor. A concern with implementing a partial fencing plan over a relative short distance is the potential for “fence end effect” where wildlife follow the fence to the end and simply cross the highway at that location. This creates a concentration of wildlife crossing and increased potential for collision with the travelling public. The selection of the fencing segment’s fence end locations considered fence end effect and attempted to mitigate against its adverse effects. The placement also is intended to facilitate a transition period over which all wildlife learn to use alternative passageways at Partridge River, and for smaller nocturnal wildlife the existing culverts within the fenced area under the Highway 107.



Figure 10: A plan to initiate partial fencing is shown for the east portion of the highway corridor. Fencing ends at potential barriers to animal movement, thereby minimizing fence end effects that could concentrate movement of animals across the highway and increase the risk of collision at the fence ends. Fence installation should follow the construction of a wildlife crossing structure (s) at Partridge River. Note wildlife features are not to scale but represent concept only.

The west end (FE3 and FE4) of the proposed fence line must reach the very edge of the watercourse (east branch of Robinson Brook) at the locations shown within the large wetland Figure 13. FE 3 is located approximately 30m from the road edge and FE 4 approximately 70m. The placement of fence ends at these locations is also adjacent to a high and steep road fill prism that is topped with a guardrail. Should animals attempt to move to the west of these fence ends the fill slope, guardrail and watercourse all present obstacles that would serve to diffuse movement and limit the potential of concentrated wildlife

crossing at this initial west fence end. In the future, if the remaining section westward to Exit 17 is fenced, the fencing at east branch of Robinson Brook will need to be realigned over the head of the culvert that carries brook under Highway 107.

Maintaining wildlife connectivity between habitats north and south of the Highway 107 corridor must be achieved with proper fence routing around bridge and culvert watercourse crossings. Fencing must pass between the head of these structures and the highway so the fence does not pass over or otherwise intersect the natural watercourse. This required fencing alignment excludes wildlife from the highway yet allows wildlife to enter the structures and use them as crossing under the highway. It is detailed in the next section of this document. As shown in Figure 14, two culverts (C3 and C4) must have fencing routed over the head of the culverts. These older structures can not be retrofitted with a terrestrial ledge for small mammals, but it is possible that they seasonally become dry and would allow a movement corridor for wildlife under the highway for some species.

At the east end, the fencing approaches Mineville Road and it should end at the guardrail along Mineville Road at the two locations (FE1 and FE2) indicated in Figure 15. The road, interchange, and some residential development should partially discourage animals approaching these fence ends. However, to further limit fence end effect at the eastern end, fence end wings ~50m in length should be installed away from the highway crossing and tied into the Mineville Road guardrail. These ends will help diffuse wildlife movement should they approach the end. This segment will also require that the fence be tied into the abutments of the Partridge River Bridge where two terrestrial wildlife crossings are to be retrofitted. Installers must ensure that access to these terrestrial crossings are not impacted by the fencing. An example of how this might be achieved on the east abutment, which has a small mammal terrestrial ledge elevated above the watercourse is shown in Figure 11 and on the west abutment in Figure 12.

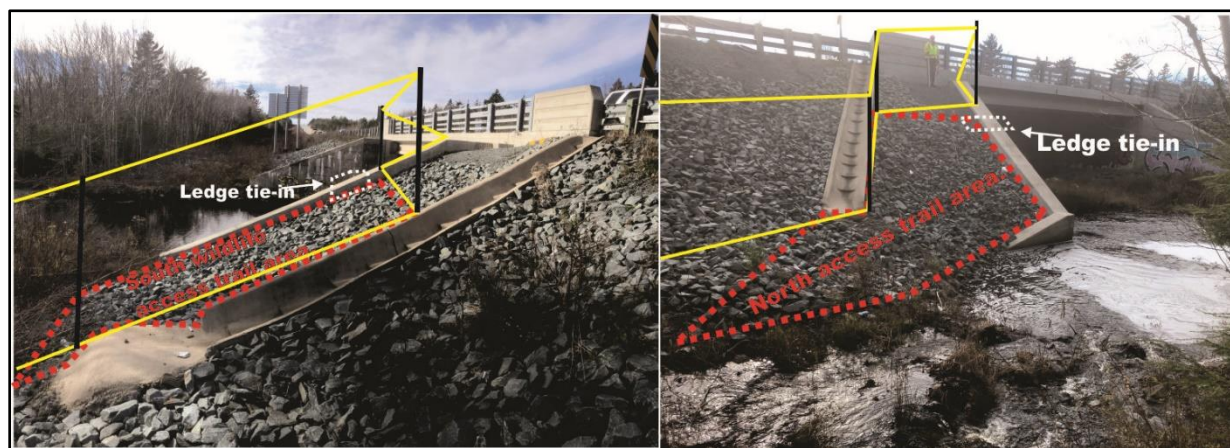


Figure 11: Wildlife fencing at Partridge River must tie into the abutments to exclude animal access to the highway but leave access to planned wildlife trails on both sides of the bridge crossing. The yellow panels and black posts provide an example of how this might be achieved both north and south of the east abutment.



Figure 12: The terrestrial wildlife path location under the west abutment at Partridge River will allow fencing to attach direction to the abutment near the base of the slope. One option is as shown, keeping fence away from winter plow snow “throw zone” near the base of the road prism where effective fence height is easily achieved based on fence alignment.

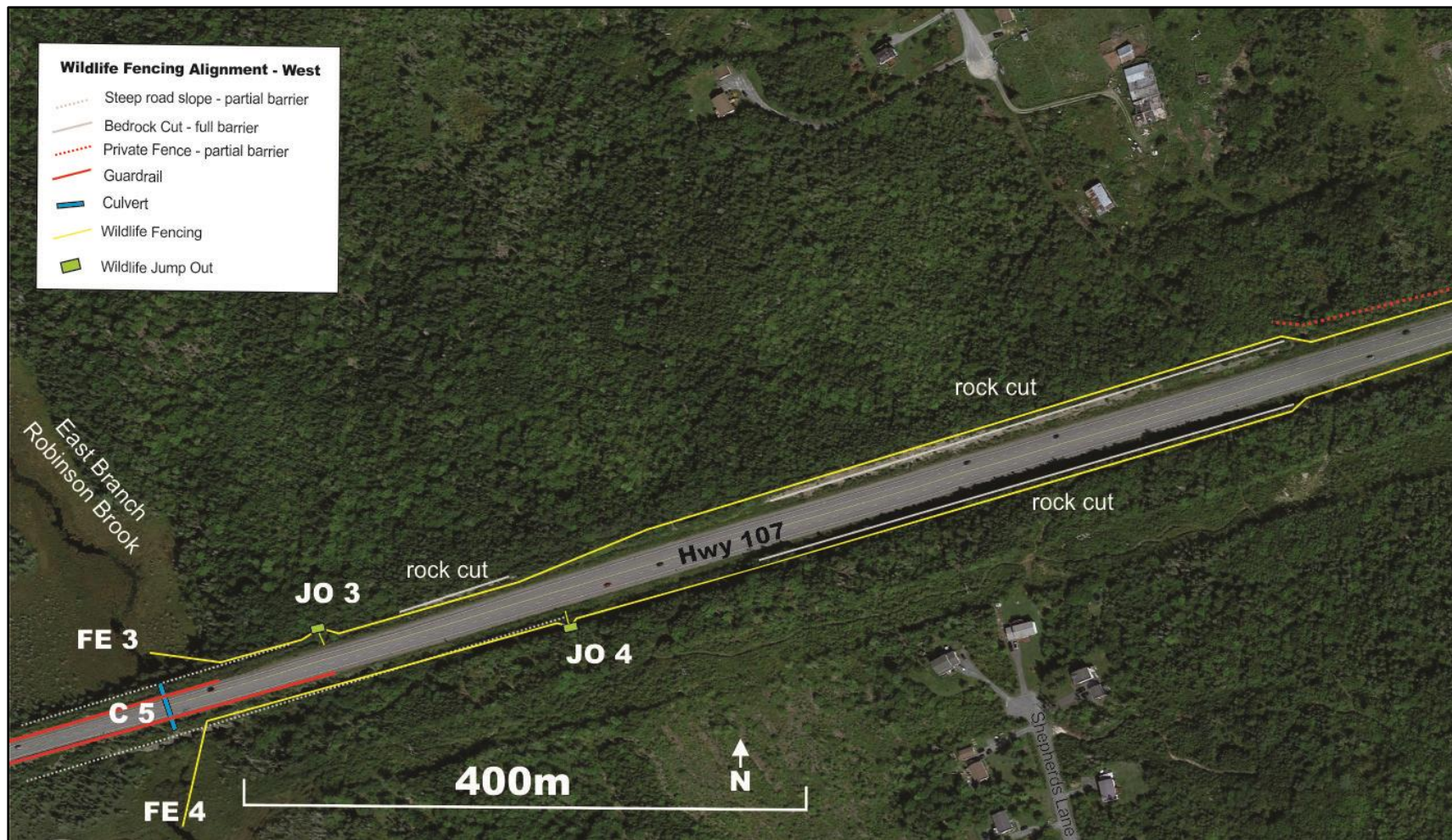


Figure 13: The general fence routing for the western fenced area ends (FE 3 and FE4) at the edge of Robinson Brook. Jump-outs (JO3 and JO4) are to be located near the bottom of the road prism but east of both the guard rail and the steepest segment of fill slope. Fencing can be run either atop the rock cuts north of Shepherds Lane as shown, or could optionally be tied into the wall of the rock cuts to omit the need for fencing through the rock cut as long as no gaps exist in the connection.

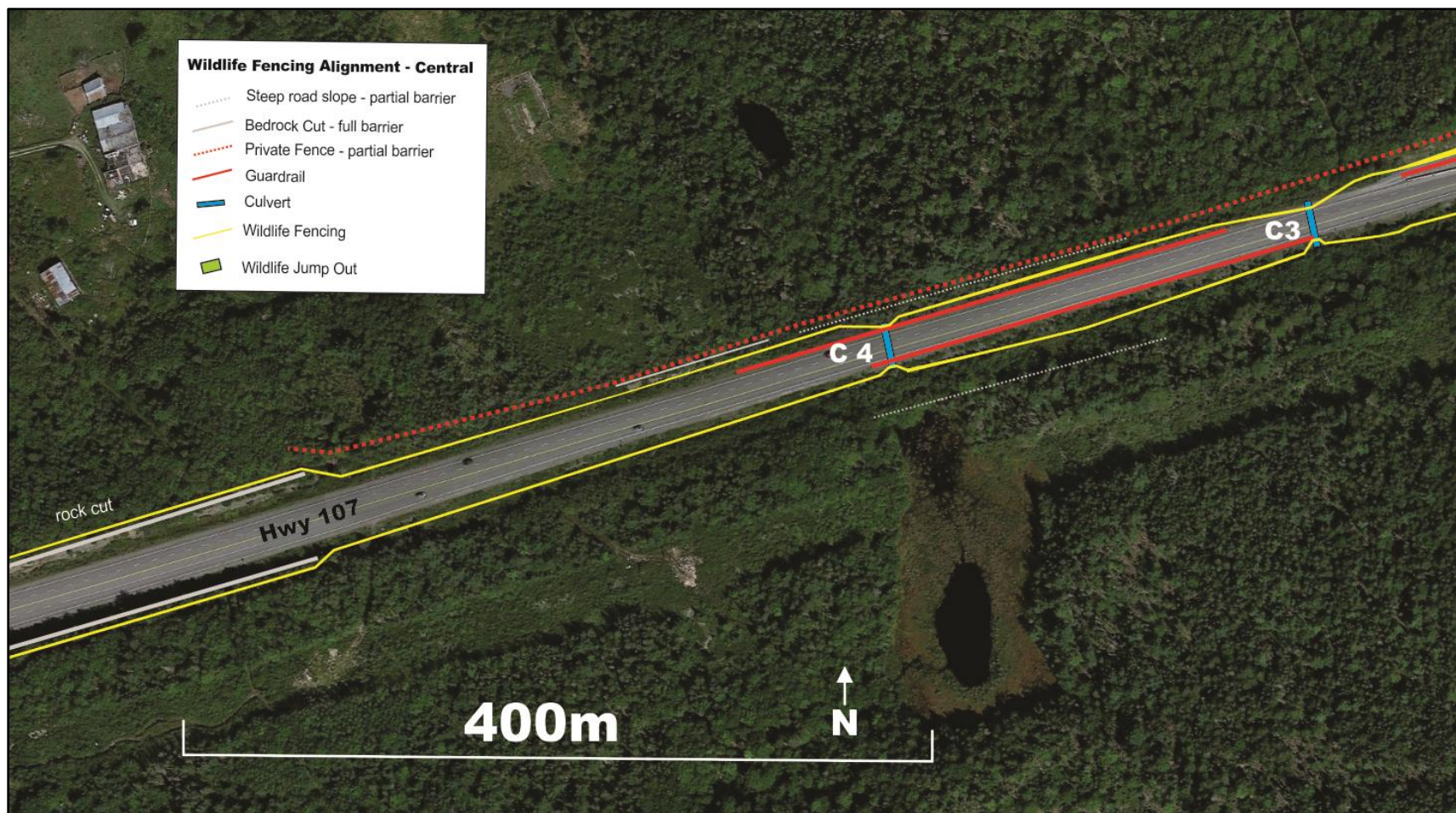


Figure 14: In the central portion of the proposed fenced area the fence will be aligned to meet installation requirements described in this document. These requirements include carrying the fence over the head of the culverts at locations C3 and C4 so that small/medium mammals might use the culverts to pass underneath Highway 107.

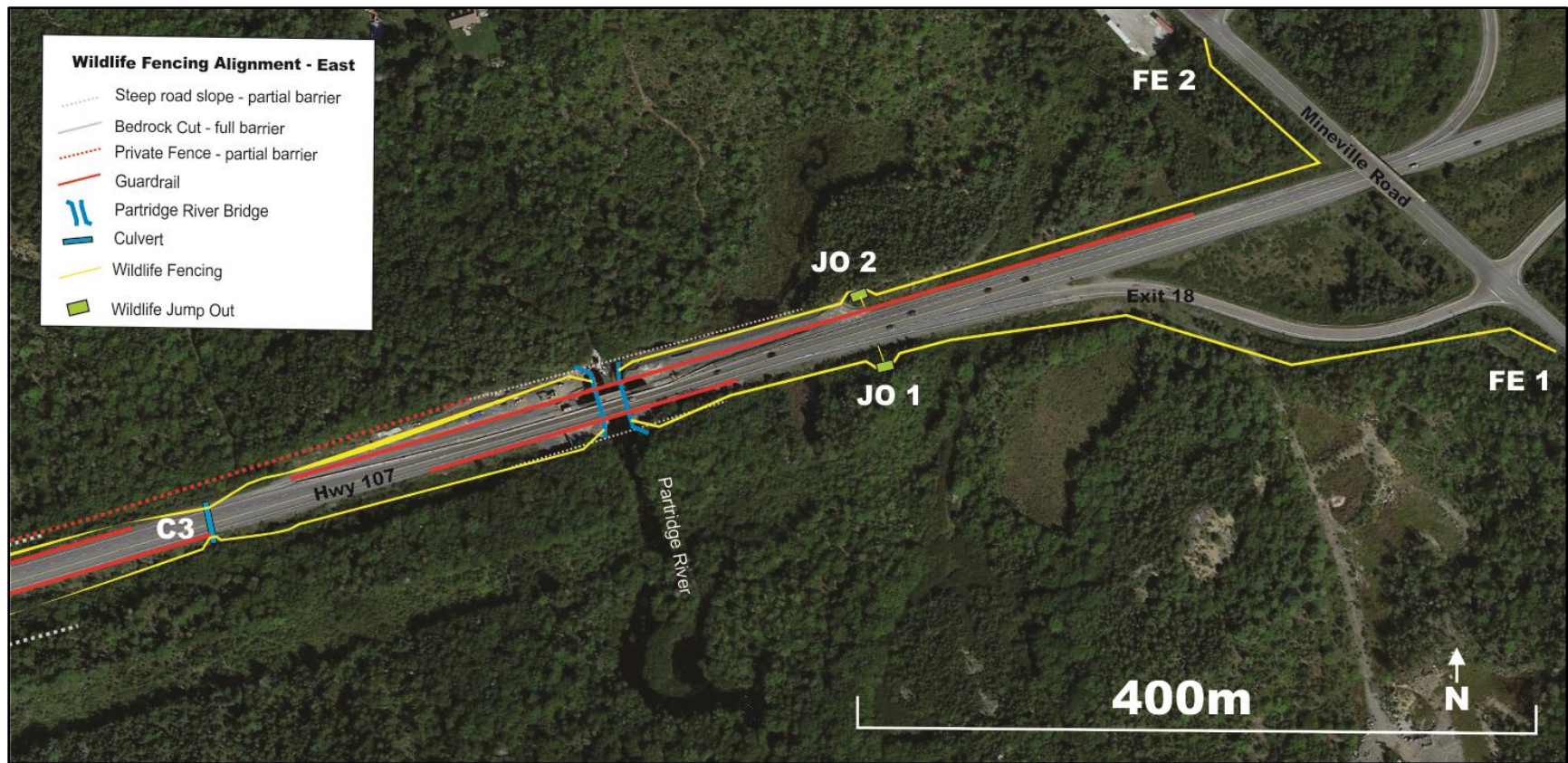


Figure 15: The west end of the proposed fencing ties into the bridge abutments at Partridge River and incorporates two Jump-outs and two fence ends. Terrestrial wildlife crossings are to be retrofitted under the Partridge River Bridge. Fence ends should end at the shoulder of the Mineville Road at the locations shown to limit the potential for fence end effect.

4.0 Jump-out Escape Measures

Escape Measures are structures that allow wildlife that may have found a way into the fenced highway corridor to safely escape to the safe side of the fencing. These structures must not allow wildlife to easily enter the highway corridor, but only to exit the corridor. Four jump-out structures have been prescribed as escape measures for the section of proposed fencing along the Highway 107 study area. Jump-outs have been chosen over other options (one-way gates) as they are effective, require little ongoing maintenance, and prevent all animals including small/medium mammals from accessing the highway corridor. Typically, these structures are placed near (~50-100m) a fence end as the fence end is the most probable location for wildlife to stray into a maintained highway fenced corridor. To minimize the probability of a vehicle/wildlife collision when an animal has strayed into the fenced roadway it is desirable for wildlife to quickly encounter the escape measure after entering the fenced highway corridor. West end jump-outs will need to be installed near the west fence ends. However, if full fencing is extended to the western end of the study area in the future, and additional jump-outs are placed near the final western fence ends, the current proposed west end jump-outs (JO3 and 4 in Figure 13) could either be removed or kept in place. In the eastern end of assessed corridor, JO1 and JO2 (Figure 15) are to be located near the base of the Highway 107 road fill prism at a location immediately east of the Partridge River bridge in close proximity to the powerline corridor. These jump-outs will assist escape from the highway corridor by any animals that may have strayed around fencing at the eastern end near the Mineville Road.

A jump-out must be 1.5-1.7m in height, have a retaining wall smooth surface that would be difficult for wildlife to climb, and have a landing pad area of at least 4m x 5m on the safe side of the jump-out. The landing pad is to be created by laying 20cm+ of washed pea gravel over a heavy landscape fabric. A section of guide fence run perpendicular to the highway from the edge of the road to within ~2m of the top of the jump-out is required to help direct approaching wildlife to the safe side of the jump-out. Similarly, a short step out section of fencing is required to improve use of the jump-out. These jump-out requirements are shown in Figures 16 and 17.

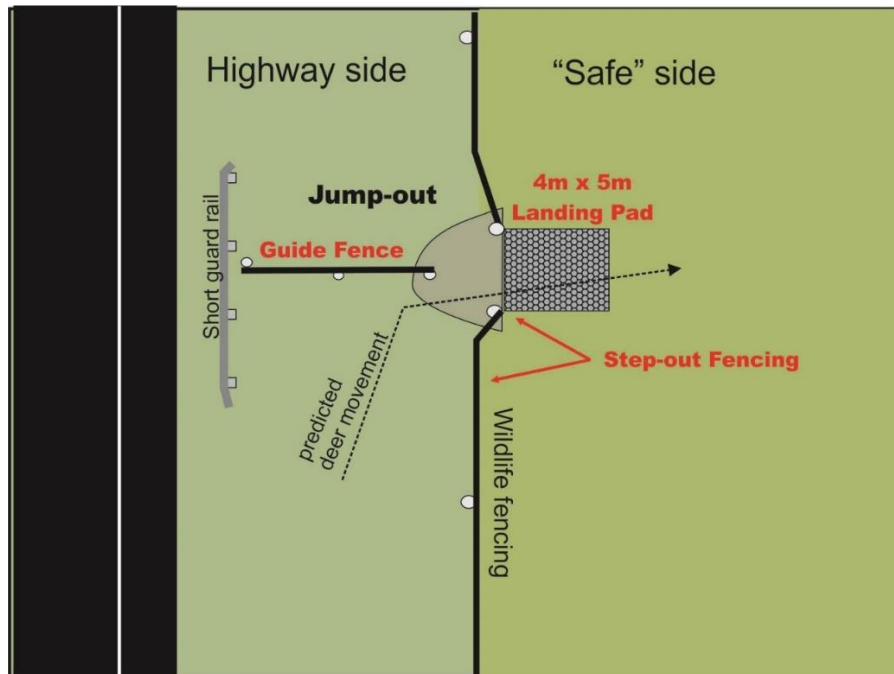


Figure 16: This schematic shows a typical Jump-out structure. A short section of guide fence run perpendicular to the highway helps direct wildlife toward the jump-out.



Figure 17: A jump-out should be 1.5-1.7m in height, have a smooth surface that would be difficult for wildlife to climb, and have a landing pad area of at least 4m x 5m created by laying 20cm+ of washed pea gravel over a heavy landscape fabric. A section of guide fence run perpendicular to the highway from the edge of the road to within 2m of the top of the jump out is missing from this structure that was still under construction at the time of capturing the photo.

4.1 Jump out Placement Requirements

To ensure proper field placement of a jump-out structure several site specific requirements exist. Not implementing the following requirements can lead to an ineffective jump-out and increase the probability of a wildlife/vehicle collision. These requirements must be established.

First, jump-outs must be placed relatively near (~10-15m) the highway or the base of road prism. The selected location must have terrain that is flat or sloping gently away from the highway on the safe side of the jump-out. This allows wildlife to jump down to natural terrain elevation. The landing area should not be an excavated hole as this will gather water and silt that will eventually render the landing pad area unsuitable. If necessary, the highway side approach can be mounded to achieve the target drop height of 1.5-1.7m on the safe side, but a relatively flat approach from the highway side is preferable.

Second, a jump-out is to be 1.5-1.7m from the top of the landing pad to the top of the jump-out including any soil added to cover retaining blocks. Installation must account for both the landing pad thickness (~20cm) and any backfill material over the top of retaining blocks (~20cm) so that the height of the jump out does not fall outside of the target range.

Third, a jump-out must not be placed at the top of a hill or cut slope. Visually this makes it more difficult for wildlife to find the escape measure and can complicate construction to meet other structure requirements.

Fourth, the landing pad must be constructed of washed pea gravel of 20+cm thickness placed over heaving landscaping fabric. Angular stone or material with soil/fines must not be used. The pea gravel makes for a soft landing and will help prevent injury to the animals using the jump-out, particularly smaller fawn that would be prone to leg injuries. The clear gravel also means that the pad will shift under foot and prevent animals from successfully jumping from the pad up over the jump-out and into the highway corridor. Finally, ensuring that fines/soils are not in the pad and that landscape fabric is placed under the pea gravel will help limit vegetation growth that would eventually firm up the landing pad surface rendering it less suitable for the intended use.

Fifth, fencing requirements around a jump-out include a short “guide fence” that runs perpendicular to the highway and helps guide wildlife toward the jump-out. This fence must start as close to the paved edge of the highway as permissible and may need to be protected with a short section of guardrail. The guide fence should end no further than 2-3m from the top of the jump-out. Additionally, the wildlife fencing parallel to the highway must have a short “step-out” section that angles toward the safe side of the fence as shown in Figure 16. In conjunction with the guide fence the step out helps direct wildlife toward the jump-out and the safe side of the fenced highway corridor.

5.0 Future Project Extension

It is understood that extension of wildlife fencing westward to Exit 17 may occur. It is recommended that if future wildlife fencing should extend westward past Exit 17 to the Salmon River bridge (see Figure 4) to prevent an increased risk of vehicle/wildlife collisions at the fence end. Ending the fence closer to Exit 17 would have higher probability of creating a fence end effect, concentrating wildlife crossing attempts of highway at the western fence end regardless of the type of fence end treatments. Fencing layout must also ensure access to all existing culverts under Highway 107 such that they may be used by small/medium mammals for crossing under the highway.

Additionally, if fencing is to be extended to the area of Exit 17, a second large mammal crossing must be installed nearer Exit 17 prior to fencing in order to maintain wildlife habitat connectivity. The current wildlife crossing location CR4 (see Figure 4) would appear, based on assessment to date, to be the most appropriate location for a second large mammal crossing to be established. Elevated terrain on either side of the highway in that area could make it feasible to establish a small overpass structure that would connect significant natural habitats of large mammals north and south of the highway. An overpass (see Figure 18) has benefits of being accessible to all wildlife, daylight, and easy to naturalize. Overpasses tend to be highly successful in gaining wildlife use over time. Overpass drawbacks would include cost, engineering challenges, and potential use by OHV and humans to the detriment of wildlife use.



Figure 18: As shown in this Google Earth image, a structure similar to the light overpass crossing for OHV's west of Exit 26 on the Hwy 101 could form the basis of a wildlife overpass at CR4 on Highway 107. A natural substrate trial surface and side panels to obscure traffic movement would need to be incorporated into the final design.

Alternatively, a large mammal underpass structure in the area of CR3, where topography drops from the road surface, would also work well for maintaining wildlife connectivity. A large box or arch culvert that produced a head height of 4m and a width >3m could achieve required lightness (openness ratio), accommodate substrate and naturalization amendments, and potentially be less susceptible to OHV and human access than an overpass. However, an underpass would require disturbance of the highway and inconvenience to the traveling public for the period of construction. Either of these two locations (CR3 and CR4), along with the establishment of a large mammal terrestrial corridor at Partridge River, would provide balanced wildlife connectivity in both the east and western ends of the study corridor.

A final, but less desirable option for a second large mammal crossing, would be construction of a large mammal overpass at the rock cut of near CR2. This location would work well within topography, but would be less likely to provide good north south connectivity between habitat areas 1 and 2 located west of east branch of Robinson Brook (Figure 4) and is therefore less desirable than either location CR3 or CR4.