One-Way Gates in Wildlife Fencing to Reduce Wildlife-Vehicle Collisions for Small- and Medium-Sized Animals

Requested by
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The Caltrans Division of Research, Innovation and System Information (DRISI) receives and evaluates numerous research problem statements for funding every year. DRISI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field.

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Executive Summary

Background

Caltrans uses wildlife fencing in conjunction with wildlife crossing structures to keep animals away from highways. Despite these efforts, animals sometimes enter the highway right of way. One-way escape gates installed within the fencing are designed to allow animals in the right of way to return to their habitat.

One-way gates are typically designed for large animals such as deer, which pose the greatest safety risk for drivers. A 2012 Caltrans study found that one-way tined gates installed on State Route 23 in Ventura County allowed small- and medium-sized mammals to pass through in both directions, providing easy passage of those species onto the highway.

Caltrans is interested in identifying both effective and cost-effective one-way gate designs that will deter small- and medium-sized mammals from entering the right of way. Target species for the State Route 23 study area include coyotes, bobcats, skunks, raccoons and possums. Caltrans is also interested in related information on fencing and jump-outs applicable to smaller mammals. To support this effort, this Preliminary Investigation sought to gather information on effective designs for one-way gates, jump-outs and fencing, especially quantitative data. CTC & Associates interviewed several experienced practitioners and researchers in this area, and conducted a literature search to identify relevant research.

Summary of Findings

Through a literature search and interviews with researchers and practitioners, we were unable to identify existing research that provides quantitative data on the effectiveness of specific escape measures for small- and medium-sized mammals. However, an in-progress NCHRP research project due to be completed in 2015 is expected to provide comprehensive guidance, including a cost-benefit analysis, on fencing and escape measures for a range of species. The experts we interviewed also provided suggestions regarding escape measures that could be tested with smaller animals.

National Research and Guidance

Several guidance documents on reducing wildlife-vehicle collisions and constructing wildlife crossings have been published in recent years, including a 2008 Report to Congress and an accompanying best practices manual. These studies provide a thorough review of national and international practices, including sections on wildlife fencing and escape measures. The most recent guidance documents either omit discussion of one-way tined gates or note that they are no longer recommended for use; escape ramps/jump-outs are preferred.

An in-progress NCHRP study (Project 25-25, Task 84) is the first national study solely focused on wildlife fencing and escape measures. This project, “Development of Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures,” is expected to provide in-depth guidance on how to construct effective fencing treatments and escape opportunities for a range of species. The project does not include quantitative testing of escape measures’ effectiveness with specific species, but it includes a survey of agencies’ experiences. Principal investigator Marcel Huijser of the Western Transportation Institute co-authored all of the recent Federal Highway Administration (FHWA) guidance on wildlife crossings, including the 2008 Report to Congress.

NCHRP staff provided us with a draft copy of the project's first product, an extensive literature review. The project's second task, a report on the survey of agencies, is expected by August 15, 2014, and the final report is expected to be complete in 2015.

State Research and Related Resources

State Research

Most state studies have focused on mitigation measures for ungulates such as deer and moose, which have a greater impact on highway safety than smaller animals. We did not identify any studies focused specifically on small- and medium-sized mammals such as coyotes, bobcats, skunks, raccoons and possums. The 2012 Caltrans study of State Route 23 is among the most thorough in the literature in terms of the level of monitoring conducted on the use of escape measures in the field.

We identified several studies and guidance documents that mention escape measures for smaller animals or may have some applicability to them, including:

- Arizona DOT has considered using one-way hinged doors (badger gates) for small animals and has developed a modified design for these gates.
- Georgia DOT recently tested deer fencing with an attached outrigger (an angled overhanging top section that creates an additional barrier in one direction.) One of our contacts suggested that this design could be modified to create a one-way escape measure for smaller species.
- Staff at the British Columbia Ministry of Transportation and Infrastructure has modified the traditional tined gate design and has begun testing a tapered jump-out design.

We also located studies that describe one-way gates using designs other than the most common tined gate style:

- Arizona DOT tested animal-activated electronic gates, but they did not work consistently and required too much maintenance. The gates are no longer in service.
- Washington State DOT has installed one-way push gates intended for use by both wildlife (ungulates such as deer) and people.

International Research

- An Australian study tested exclusion fencing for foxes, feral cats and rabbits, finding that a curved overhang provided an effective one-way barrier for the climbing species.

Related Research

This section summarizes a few studies that have provided quantitative data on the effectiveness of escape measures (one-way gates and escape ramps) for large ungulates.

Consultation with Practitioners and Researchers

We interviewed several experienced practitioners and researchers about their experiences with escape measures for small- and medium-sized animals. They agreed that there is little quantitative data on the effectiveness of fencing and escape measures in general, and that what exists is focused on large ungulates.

Below is a summary of the key takeaways from our interviews.

Gate Design

- No single escape gate design is effective for all sizes of animals.
- Gate designs should be simple, with minimal moving parts, to reduce maintenance needs. Arizona DOT tested animal-activated electronic gates, but concluded that they require too much maintenance to be practical, and they are no longer in use.
- Using perpendicular fence sections or "funnel fencing" is recommended to help guide wildlife to escape opportunities.

Tined Gates

- Tined gates are the most common one-way gate design for ungulates like deer, elk and moose.
- Agencies have begun looking for alternatives to tined gates because the gates often become damaged by people and wildlife, and because some designs have injured animals.
- The British Columbia Ministry of Transportation and Infrastructure has modified its tined gate design, adding balls or disks to the tine ends to make them safer for animals.

Gates for Smaller Animals

- Swing-style "badger gates"—small, hinged doors inserted in wildlife fencing at ground level—were the only style of gate identified that is specifically designed for smaller mammals. No data on the effectiveness of these gates was identified.
- This type of gate requires periodic maintenance to ensure that it is swinging freely and is unobstructed by debris or vegetation. A cement slab beneath the gate can help reduce maintenance needs.
- This gate design appears to be more common in Europe than in the United States. Staff at Arizona DOT has considered trying these gates.

Alternative Designs for Smaller Animals

Several of our contacts suggested gate and fencing design modifications that could help better target small- and medium-sized animals. These suggestions included:

- Shorter-height sections of fencing with an angled outrigger at the top (angled posts that create an overhang of the wire fencing) could be installed within the existing fence. In Georgia, this design has created an effective one-way barrier for deer, which will only jump the fence in one direction; this design could be tested with medium-sized mammals as well. In Australia, a flexible curved overhang at the top of the fence provided a greater barrier to foxes and feral cats than a rigid barrier.
- To keep smaller animals from using one-way tined gates in the wrong direction, the gate could be elevated 2 to 3 feet to create a gate/jump-out combination. This would deter animals such as rabbits, but not skilled climbers such as raccoons. The area beneath

the gate could be regular fencing material, or the bottom few feet of tines could be interlaced.

- Branches could be stacked against the road side of the fence to create an escape opportunity for medium-sized animals. This strategy has reportedly been used in Spain as an escape opportunity for the Iberian lynx.
- A large PVC pipe could be installed through fencing to allow small animal passage. The pipe could have a spring-loaded door on one side (made of wire mesh to let light through) and could be elevated 2 to 3 inches above the ground on the outside to minimize issues with debris and dirt from rain events.

Escape Ramps/Jump-Outs

- At some agencies, a shift is underway toward using earthen escape ramps (jump-outs) rather than one-way gates. Depending on the construction materials used, jump-outs require little to no maintenance but may be more expensive to construct than gates. Jump-outs are most effective when their height is carefully designed for a specific target species (or multiple similar species).
- No one was aware of documentation of small animals using jump-outs. However, coyotes have been documented using jump-outs, according to the 2008 Report to Congress (referencing a 2002 Canadian study).

Captive Animal Testing

- Using captive animals to test whether a target species will use a specific escape measure was supported by those we interviewed. Although this test method cannot duplicate real-world conditions, it can provide preliminary information about effective designs before agencies invest in installing them.

Human Access Through Fencing

- In areas where people want to cross wildlife fencing, our contacts generally preferred the approach of trying to address their desire for access. Several felt that there is no way to keep motivated people from crossing (and often damaging wildlife gates or fencing in the process).
- The British Columbia Ministry of Transportation and Infrastructure recently developed warning signs for jump-outs (“Fall Hazard” and “Do Not Enter” signs); similar signs could be used with one-way gates.
- Swing-style one-way gates were a commonly mentioned design for human access. Turnstile gates and angled fence openings were also mentioned.
- Washington State DOT has installed one-way push gates designed to be used by both animals (ungulates) and people.

Gaps in Findings

As mentioned above, we did not identify any quantitative data on the effectiveness of specific escape measures for small- and medium-sized mammals. We also did not find data on escape measures' cost-effectiveness for these species; however, the in-progress NCHRP project on wildlife fencing and escape measures will include a cost-benefit analysis.

Next Steps

Caltrans might consider the following in its continued evaluation of escape measure designs:

- Reviewing the results of the in-progress NCHRP project on wildlife fencing and escape measures (Project 25-25, Task 84) as they become available. A draft interim report on the project's survey of agencies is expected to be ready for NCHRP review by August 15, 2014, and the project's final report is expected in 2015.
- Maintaining contact with researchers at the Western Transportation Institute, especially Marcel Huijser and Tony Clevenger. As principal investigator on the in-progress NCHRP project, Huijser may be able to provide insight on the results of that project as portions of it are completed.
- Following up with state agencies that are testing or monitoring new fencing, gate and jump-out designs, such as Georgia DOT, Washington State DOT and the British Columbia Ministry of Transportation and Infrastructure. These projects are targeting large ungulates, but contacts at these agencies may provide insight into the designs' applicability to smaller mammals.
- Testing potential escape measure designs using captive animals of the target species.

Detailed Findings

National Research and Guidance

This section includes an in-progress study and several guidance documents that synthesize current practices. These documents include an international perspective as well; the approaches of other countries are well-represented.

In-Progress National Research

"Development of Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures," NCHRP Project 25-25, Task 84. Principal investigator: Marcel Huijser, Western Transportation Institute, Montana State University. Final report expected in 2015.
http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3509
This project's objectives are to (1) review and compile existing applications and practices for the use of wildlife fencing, escape measures, lateral access control measures and end run prevention applications; and (2) develop guidelines for effective future applications of these measures. The guidelines will address selecting fencing locations, aesthetics considerations and cost-effectiveness regarding initial construction and long-term maintenance costs.

Study tasks include a literature review, a survey of agencies, a cost-benefit analysis and development of construction guidelines. The project has experienced delays, and the survey report (the second of six project tasks) is now expected by August 15, 2014, Jencks said. The project is expected to take several more months to complete, with the final report expected in 2015.

We spoke with principal investigator Marcel Huijser (see **Consultation with Practitioners and Researchers**); however, Huijser declined to speak directly about this project because it is still in progress.

Recently Completed National Research

Wildlife Crossing Structure Handbook: Design and Evaluation in North America, Anthony P. Clevenger and Marcel P. Huijser, Federal Highway Administration, March 2011.
http://www.cflhd.gov/programs/techDevelopment/wildlife/documents/01_Wildlife_Crossing_Structures_Handbook.pdf
This FHWA handbook on crossing structures has a brief section on fencing and gates beginning on page 169. Tined gates are not included in the discussion of escape mechanisms. Individual "Hot Sheets" discuss applications, design details and maintenance considerations:

- Hot Sheet 12, "Fencing—Large Mammals," page 169.
- Hot Sheet 13, "Fencing—Small and Medium Vertebrates," page 181.
- Hot Sheet 14, "Gates and Ramps," page 183.
    - A spring-loaded gate for people that includes steps to allow for snow cover is shown on page 172.

Wildlife-Vehicle Collision Reduction Study: Report to Congress, M.P. Huijser, P. McGowen, J. Fuller, A. Hardy, A. Kociolek, A.P. Clevenger, D. Smith and R. Ament, Federal Highway Administration, August 2008.
http://www.fhwa.dot.gov/publications/research/safety/08034/08034.pdf (PDF version);
http://www.fhwa.dot.gov/publications/research/safety/08034/index.cfm (HTML version)
This Report to Congress contains the findings of a national wildlife/vehicle collision (WVC) reduction study conducted as a requirement of the SAFETEA-LU highway funding legislation. The study's goals were to advance the understanding of the causes and impacts of WVCs and identify solutions to this growing safety problem. The Best Practices Manual (see page 9 of this Preliminary Investigation) was also created as part of the study.

Chapter 8 of the Report to Congress, "Mitigation Methods That Seek to Physically Separate Animals from the Roadway," includes these relevant sections:

- "Wildlife Fencing," page 133.
- "Escape Opportunities from Right of Way," page 145.
- "Access for People Such as Hikers, Skiers, Cyclers and Fishers," page 157.

Below is an excerpt from the Chapter 8 subsection titled "Escape Opportunities from Right of Way: One-Way Gates" (pages 147-148 of the report):

> In general one-way gates are no longer recommended as wildlife can learn how to use them to get into the right of way, sometimes aided by hikers, fisherman, equestrians, and bikers who propped and tied the gates open (Bruce Leeson, personal communication).[368] In Banff National Park, Canada, an elk herd not only learned how to go through the gate the "wrong way," but they also destroyed the gate within a week after they learned how to enter the gate from the wrong side (Bruce Leeson, personal communication). In the same area, coyotes learned to crawl through the tines to feed on mice that became more abundant in the right of way now that it was no longer grazed by ungulates (Bruce Leeson, personal communication).

The Chapter 8 subsection on jump-outs cites a study in which coyotes were documented using jump-outs (page 146). We were unable to locate a catalog entry for this study. Below is the citation as it appears in other studies:

> **Highway Mitigation Monitoring: Three Sisters Parkway Interchange,** A.P. Clevenger, B. Chruszcz, K. Gunson, and M. Brumfit, Alberta Sustainable Resource Development, 2002.

We attempted to contact study author Tony Clevenger at the Western Transportation Institute (403-609-2127, tclevenger@coe.montana.edu) but were not able to reach him.

Wildlife Vehicle Collision Reduction Study: Best Practices Manual, M.P. Huijser, P. McGowen, A.P. Clevenger and R. Ament, Federal Highway Administration, October 2008.
http://environment.fhwa.dot.gov/ecosystems/wvc/wvc.pdf (PDF version);
http://environment.fhwa.dot.gov/ecosystems/wvc/index.asp (HTML version)
This document builds on the study's Report to Congress to provide a best practices manual for reducing wildlife/vehicle collisions. Design and implementation guidelines for wildlife fencing are provided, and escape measures are discussed. Relevant sections include:

- Section 4.2, “Wildlife Fencing” (page 28), includes a discussion of fencing for small- and medium-sized animals. This section discusses mesh size, dig barriers, fence location and fence end treatments.

- “Escape Opportunities from the Right-of-Way” (page 43).
    - Note that tined gates are not mentioned in this best practices manual.
    - Stacking branches against the fence to provide an escape route is mentioned.

Wildlife Vehicle Collision Reduction Training, Federal Highway Administration, undated.
http://environment.fhwa.dot.gov/WVCtraining/index.asp
This training program is designed as a companion to the Best Practices Manual. Wildlife fencing is discussed in Module 4 (http://environment.fhwa.dot.gov/WVCtraining/mod4/module_4_3.asp).

Wildlife Crossings Toolkit, National Park Service and U.S. Forest Service, 2002 with ongoing updates.
http://www.fs.fed.us/wildlifecrossings/index.php
This online resource focuses on crossing structures, but contains a few references to fencing.

- See http://www.fs.fed.us/wildlifecrossings/case-histories/other/GlennHighway.php for a case study with an illustration of “funnel fencing” designed to direct moose to one-way gates.

State Research and Related Resources

State Research

California

Effects of State Route 23 Widening Project and Accompanying Mitigation Measures on Culvert Use and Road Mortality of Wildlife, Jeff Sikich and Seth Riley, Caltrans, May 2012.
http://www.nps.gov/samo/parknews/upload/SR23-Final-Report.pdf
This project studied the effectiveness of three measures to reduce road impacts on wildlife, particularly medium- and large-sized mammals, along State Route 23 in Ventura County, CA, following a lane expansion. The mitigation efforts included clearing out underpasses that were filled with sediment, constructing exclusion fences and installing one-way escape gates. Researchers monitored wildlife movement across the highway from January 2004 through August 2011, and monitored the use of the new one-way gates.

We spoke with report co-author Jeff Sikich about this project (see **Consultations with Practitioners and Researchers**).

Arizona

Wildlife Escape Measures, Arizona Department of Transportation, undated.
http://www.azdot.gov/docs/default-source/planning/description_of_wildlife_escape_measures.pdf
This nine-page document summarizes the escape measures Arizona DOT has used, primarily for large ungulates. Relevant sections include:

- "One-Way Gates," page 1.
- "Escape Measures for Smaller Wildlife," page 5.
    - ADOT has explored using a hinged gate (badger gate) for smaller animals and has considered modifying the gate design to have a Plexiglas door panel instead of wire mesh. A perpendicular fence panel would be used to slow and guide animals toward the gate (see page 6).
    - Page 9 provides a table of evaluation criteria for escape measures. One-way gates are categorized as a low-applicability measure with low effectiveness; escape ramps are preferred.

Preacher Canyon Wildlife Fence and Crosswalk Enhancement Project Evaluation, Jeffrey W. Gagnon, Norris L. Dodd, Scott C. Sprague, Kari Ogren and Raymond E. Schweinsburg, Arizona Department of Transportation, February 2010.
http://www.azgfd.gov/w_c/documents/Preacher_Canyon_Elk_Crosswalk_and_Wildlife_Fencing_Enhancement_Project_2010.pdf
The escape measures in this project included standard measures as well as a pair of experimental animal-activated self-opening electronic gates. The electronic gates were opened with a break-beam photo sensor placed along the fence far enough in advance of the gate so animals did not see movement of the gates as they opened; the gates closed automatically after two minutes. The gates were solar-powered. See page 20 of the report.

Study co-author Norris Dodd, now with Arizona DOT, reported that the electronic gates stopped functioning correctly and are no longer in use (see **Consultation with Practitioners and Researchers**).

British Columbia

"The Evolution of Wildlife Exclusion Systems on Highways in British Columbia," Leonard E. Sielecki, *Proceedings of the 2007 International Conference on Ecology and Transportation*, British Columbia Ministry of Transportation, May 2007.
https://escholarship.org/uc/item/50s874mq
This paper describes the evolution of the agency's tined gate design to make the tines safer for animals (see pages 461-462). The preferred design now features metal balls or disks on the ends of the tines to prevent animal impalement.

Sielecki provided us with specifications for the tined gates (Appendix A). The gates are described on page 2 of Section 700, and drawings begin on page 17.

WARS 1988-2007: Wildlife Accident Reporting and Mitigation in British Columbia, Special Annual Report, British Columbia Ministry of Transportation and Infrastructure, 2010.
http://www.th.gov.bc.ca/publications/eng_publications/environment/references/WARS/WARS_1988-2007/WARS_88-07_Section-04W.pdf
Chapter 4 of this report contains additional photos of the agency's tined gates (see pages 4-11 to 4-13).

Georgia

Development and Evaluation of Devices Designed to Minimize Deer-Vehicle Collisions (Phase II), David A. Osborn, William D. Gulsby, Daniel W. Stull, Bradley S. Cohen, Robert J. Warren, Karl V. Miller and George R. Gallagher, Georgia Department of Transportation, December 2010.
http://ntl.bts.gov/lib/42000/42900/42989/07-02_Phase_II.pdf
This project tested the efficacy of several fencing designs for restricting movements of captive deer. Researchers found that a relatively short woven-wire fence (1.2 meters high) with a top-mounted outrigger could effectively function as a one-way barrier. See page 99 of the report for a photo of the outrigger design, which created a 45-degree overhang at the top of the fence. In tests with captive deer, the deer could not be enticed to jump the fence when the overhang was angled toward them.

Two Phase III studies are in progress to pilot-test experimental fence designs, examining their effectiveness with deer over multiple seasons and determining cost, durability and maintenance needs.

- Phase III, Part A: http://trid.trb.org/view/2012/P/1314051.
- Phase III, Part B: http://trid.trb.org/view/2013/P/1249168.

Contact: Project manager David Jared, Georgia Department of Transportation, 404-608-4799, djared@dot.ga.gov.

Washington State

US 97A Wildlife Fence Project, completed September 2011.
http://www.wsdot.wa.gov/Projects/US97A/WildlifeFence/default.htm
This wildlife fencing project included the installation of one-way push gates designed to be used by both people and wildlife. The gates are hinged at the top and swing one way uphill; gravity closes them. Deer and bighorn sheep were among the species targeted in this fencing project. See a photo of one of the gates at http://www.wsdot.wa.gov/Projects/US97A/WildlifeFence/photos.htm#gate.

We contacted Kelly McAllister, a wildlife biologist at Washington State DOT, who said the agency has not documented how often the push gates are used by animals or what species use them, though they have reportedly been used successfully by deer. McAllister said the gates seem to be a decent design; they can only be pushed in one direction and fall closed with gravity as intended.

McAllister noted that despite Washington State DOT's efforts to provide access opportunities for people, a person cut through the wildlife fencing very close to one of the push gates; she hypothesized that the person may not have noticed the gate or may have thought it was too difficult to go through.

Contact: Kelly McAllister, Wildlife Biologist, Environmental Services Office, Washington State Department of Transportation, 360-705-7426, mcallke@wsdot.wa.gov.

International Research

Wildlife Habitat Connectivity Across European Highways, Federal Highway Administration, International Technology Exchange Program, August 2002.
http://international.fhwa.dot.gov/Pdfs/wildlife_web.pdf
This report documents the findings of an international scan tour of five European countries. Most applications described in the report are also reproduced in the most recent FHWA reports on this topic (see **National Research and Guidance**). Relevant sections include:

- Fence applications are described and shown on pages 14-15 or the report.
- A hinged door (badger gate) for small mammals is shown on page 16.

"The Efficacy of Feral Cat, Fox and Rabbit Exclusion Fence Designs for Threatened Species Protection," K.E. Moseby and J.L. Read, *Biological Conservation,* Vol. 127, No. 4, pages 429-437, February 2006.
Abstract at http://www.sciencedirect.com/science/article/pii/S0006320705003538; synopsis at http://www.conservationevidence.com/individual-study/125
This Australian study found that a 60-cm curved "floppy" overhang of netting supported by heavy-gauge wire created a more effective exclusion barrier to red foxes and feral cats in captive testing than a 30-cm overhang angled upwards. Electric wires offset from the netting (delivering a small shock to the animals) further improved the netting's effectiveness.

Related Research

The following studies are among those that have collected data on the effectiveness of specific escape measures. These studies focus on deer and other large ungulates.

Effectiveness of Earthen Return Ramps in Reducing Big Game Highway Mortality in Utah, John A. Bissonette and M. Hammer, Utah Department of Transportation, November 2000.
Abstract at http://trid.trb.org/view/2000/M/691279
This study compared the performance of escape ramps and traditional one-way gates in Utah, finding that escape ramps were eight to 11 time more effective with deer than one-way gates. Researchers' cost-benefit analysis suggested that the cost of installing escape ramps would be rapidly offset by reduction in deer mortality.

"Evaluation of 2.4-M Fences and One-Way Gates for Reducing Deer-Vehicle Collisions in Minnesota," J. Ludwig and T. Bremicker, *Transportation Research Record 913*, pages 19-22, 1983.
Abstract at http://trid.trb.org/view/1983/C/196995
This study monitored the use of one-way gates on Interstate highways in Minnesota for 18 months, finding that 69 percent of 51 passages through the gates were in the intended direction.

"Use of One-Way Gates by Mule Deer," D.F. Reed, T.M. Pojar and T.N. Woodard, *Journal of Wildlife Management,* Vol. 38, No. 1, pages 9-15, January 1974.
Abstract at http://trid.trb.org/view/1974/C/115489
This foundational study tested two types of one-way gates designed for mule deer, then monitored the use of eight gates installed on Interstate 70 near Vail, CO. During the study period, researchers found that 96 percent of the passages through the gate were in the intended direction, allowing about 223 deer to escape the right of way.

Consultation with Practitioners and Researchers

Below we summarize our conversations with practitioners and researchers who are experienced with wildlife fencing and escape measures.

California (National Park Service)

Contact: Jeff Sikich, Biologist, Santa Monica Mountains National Recreation Area, National Park Service, 805-370-2395, jeff_sikich@nps.gov.

Sikich co-authored the 2012 Caltrans study of wildlife mitigation efforts on the State Route 23 widening project in Ventura County.

Gates for smaller animals: Sikich was not aware of any one-way gate designs for smaller animals besides the swing-style badger gate. He noted that the swing-style gates require some maintenance to make sure they are swinging freely, unobstructed by debris or vegetation.

Escape ramps/jump-outs: While there are six gates per side in the State Route 23 study area, installing three jump-outs per side in key areas should be sufficient, Sikich said. He believes these would be effective for coyotes and bobcats, but said raccoons would likely be able to climb both up and down the ramps, and was unsure whether skunks would use them. A key benefit to jump-outs is that they require little to no maintenance.

Human access through fencing: As noted in the 2012 report on the State Route 23 project, Sikich suggested putting a human gate at the locations with highest human traffic to prevent damage to tined gates.

Captive animal testing: Testing escape mechanisms using captive wildlife was mentioned as a methodology that could give preliminary information about which species will use a specific gate design.

- Sikich suggested that another option would be to install more than one type of escape mechanism (jump-outs, different styles of gates) and monitor their effectiveness.

Western Transportation Institute

Contact: Marcel Huijser, Research Ecologist, Western Transportation Institute, Montana State University, 406-543-2377, mhuijser@coe.montana.edu.

Huijser is the principal investigator for the in-progress study NCHRP Project 25-25, Task 84, "Development of Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures." He was the lead author on the 2008 Report to Congress on FHWA's Wildlife/Vehicle Collision Reduction Study, and co-authored the accompanying Best Practices Manual. He also co-authored FHWA's 2011 Wildlife Crossing Structure Handbook.

Huijser declined to discuss details of the in-progress NCHRP study, but spoke in general terms about his experience with escape measures and fencing.

From a big-picture perspective, Huijser recommended that agencies strive to be explicit about which species they want to mitigate for and why (driver safety, protecting endangered species, etc.), and about their criteria for selecting road sections for mitigation. He noted that road

sections are often selected based on crash and carcass data and effects on human safety rather than where connectivity is needed most for specific species. He framed this not as a criticism of existing mitigation efforts, but encouraged this type of examination as an aid in decision-making.

Since no single escape mechanism is effective for all species, Huijser recommended that agencies determine their target species and select escape mechanisms for those species, acknowledging that a one-way escape mechanism for one species may constitute a two-way barrier or be completely permeable to others.

Huijser noted that fencing design is a key consideration. Mesh size is a factor, as small animals such as possums can squeeze through fairly small spaces. Animals that are skilled climbers may be able to climb the fence, making escape measures for them unnecessary.

Gates for smaller animals: Huijser did not have a definitive recommendation on an escape mechanism for smaller animals. He noted that there is a lack of data regarding effectiveness of escape measures of all types. He did not know of any data on the effectiveness of swing-style badger gates.

Tined gates: Huijser is not a champion of one-way tined gates, citing the risk of injury or death to animals and the fact that they tend to be damaged and become two-way gates. Huijser co-authored the FHWA 2011 and 2008 guidance documents that omit mention of tined gates.

Escape ramps/jump-outs: Huijser believes jump-outs are probably less problematic than one-way gates. Although there has been a shift in recent years toward using jump-outs rather than tined gates for deer and other large animals, Huijser said there is a lack of data on jump-outs' effectiveness.

- Jump-out height must be designed carefully for target species. Huijser mentioned a recent situation involving jump-outs designed for white-tailed deer. Although white-tailed deer were thought to be fairly similar to mule deer, it turned out that they have far less willingness or ability to jump down.

Alternative designs for smaller animals

- **Periodic lower fence sections with outriggers:** Huijser pointed to a 2010 Georgia Department of Transportation study that found that attaching an outrigger to the top of a lower fence at a 45-degree angle (creating an overhang in one direction) was very effective with deer. The study noted that at the ideal height, this design creates a fence permeable in only one direction. Huijser suggested that agencies could test this design as an escape mechanism by incorporating shorter fence sections with attached outriggers into an existing standard-height fence.

- **Stacked branches:** With this approach, branches are stacked on the road side of the fence, up to the top of the fence, to create a jump-down opportunity for an agile climber. Huijser believes this approach was used 10 to 15 years ago in Spain as an escape measure for the Iberian lynx, but has not been able to find a study documenting it.

Captive animal testing: Huijser supports using captive animals to test whether target species will use a specific escape measure prior to installation. He pointed to a 2010 Georgia DOT study that tested multiple fence designs with deer, providing valuable information about the required

fence height and the effectiveness of attached outriggers to create an angled overhang (see **State Research**). Huijser supports more quantitative testing in general, noting that without it, designs may be replicated by multiple agencies based on presumed effectiveness that may not be borne out.

Human access through fencing: In Huijser's experience, in an area where people want to cross a fenced roadway, they will find a way, potentially creating gaps in the fence if a crossing opportunity is not provided. He acknowledges agencies' concerns about potential liability issues, but he recommends that agencies accept that people are present and work with it. He mentioned several styles of human-only gates, including swing gates set at an angle so that gravity closes them (which have been effective in western Europe), turnstile gates and Y-angled fence openings (which lack data on effectiveness).

Arizona DOT

Contact: Norris Dodd, Wildlife Connectivity Program Coordinator, Office of Environmental Services, Arizona Department of Transportation, 480-271-4334, ndodd@azdot.gov.

Before taking his current position with Arizona DOT, Dodd worked for nearly 30 years as a research biologist for the Arizona Game and Fish Department.

Small animal gates: Dodd is in favor of trying swing-style badger gates, with Plexiglas doors to increase visibility, as an escape mechanism for small animals (see **State Research**). Arizona DOT discussed this on a recent project but ended up not implementing it partly because of maintenance concerns—drainage issues and the potential for debris accumulation. Dodd would like to install concrete pads beneath these gates to mitigate those concerns.

- **Lateral fences** (perpendicular to the road) are critical in funneling animals to these gates.

Animal-activated electronic gates: Arizona DOT tried this option on a recent project (see **State Research**) for elk and deer. The gates worked as expected during testing, but in field use there were problems with the trigger system and connections, and Dodd does not recommend these gates. Simpler designs that require less maintenance are preferred.

Escape ramps/jump-outs: Dodd has seen some limited use of jump-outs by mesocarnivores. He suggested that an optimum jump-out height for coyotes, bobcats and mountain lions would be 5½ to 6 feet. He suggested creating a berm behind the jump-out to direct animals toward it.

Alternative designs for smaller animals: Dodd suggested putting a large PVC pipe through the fence with a spring-loaded door on one side (made of wire mesh to let light through). The pipe could be elevated 2 to 3 inches above the ground on the outside to minimize issues with debris and dirt from rain events.

Captive animal testing: Dodd supports using captive animals in a controlled environment to test escape measures. Arizona DOT is in the planning stages of a research project that would test captive tortoises' response to multiple fence types and drainage treatments.

Guardrails/clear zones: Arizona DOT has successfully integrated a tortoise fence with guardrail. However, the agency is moving away from guardrails in favor of clear zones. Dodd also mentioned that moving portions of the fence and escape measures farther away from the

road can give animals an area to calm down and move toward the escape measure, away from the noise and activity of the road.

Human access through fencing: Arizona DOT has experienced people cutting wildlife fencing to gain access to natural forest areas along the highway (typically public lands where access is allowed). The agency has installed human gates in the fence with signs that say "Help keep the highway safe! Please close the gate to prevent wildlife-highway collisions."

British Columbia Ministry of Transportation and Infrastructure

Contact: Leonard Sielecki, Environmental Issues Analyst, British Columbia Ministry of Transportation and Infrastructure (BCMOTI), 250-356-2255, leonard.sielecki@gov.bc.ca.

Tined gates: Over many years, Sielecki has worked to improve the design of BCMOTI's one-way tined gates to make them safer for wildlife. The agency's current design uses balls or disks on the end of the tines to prevent injury. The agency is now field-testing jump-outs in select locations.

Sielecki said one-way gates are useful in areas with narrow rights of way. The agency has had issues with people tying back the tines for easier human access.

Gates for smaller animals: BCMOTI has not provided escape mechanisms for smaller animals. The hope is that smaller animals will follow the fence line until they come to a culvert and will exit the right of way through the culvert.

Alternative designs for smaller animals: To keep smaller animals from using one-way tined gates in the wrong direction, Sielecki suggested elevating the gate 2 to 3 feet to create a one-way gate/jump-out combination. This would deter animals such as rabbits, but not skilled climbers such as raccoons. The area beneath the gate could be regular fencing material, or he suggested that the bottom few feet of tines could be interlaced.

Escape ramps/jump-outs: The agency is field-testing about eight to 12 jump-outs on the downslope sides of highways. They have been in place for a couple of years; two more will be installed this summer.

- The agency is using concrete blocks in its jump-outs, which should minimize maintenance needs compared with wood timbers. However, this raises the up-front costs; materials and installation costs are higher than for tined gates.
- The agency tested the design by herding elk toward the opening; Sielecki said that once the first elk jumped through, the others followed.
- **Human access concerns:** To deter cyclists and motorcyclists from using the jump-outs and to warn people of their presence, the agency placed boulders in front of some jump-outs, tapered the jump area to a single narrow jump point and installed signs warning of a fall hazard.

  Sielecki provided specifications for the warning signs, which include an illustration of the jump-out design (Appendix B). He also pointed to an aerial photo of a jump-out installed near Golden, BC: http://www.th.gov.bc.ca/kickinghorse/photo_gallery/aerials_june_2011/showimage.html?21

Contacts

CTC contacted the individuals below to gather information for this investigation.

State Agencies

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SECTION 700

WILDLIFE EXCLUSION FENCING

DESCRIPTION

700.01 Scope – This Section covers the construction of wildlife exclusion fencing with galvanized wire mesh, pressure treated wood poles and/or galvanized metal posts, one-way gates, lockable human access gates and double swing gates and, with reference to Drawings of the SP700 series, is intended to specify acceptable standards and some optional features as may be required by the Special Provisions.

Alternative construction may be called for by the Drawings, the Special Provisions or instructions of the Ministry Representative, and alternative methods may be acceptable upon submission to the Ministry Representative.

MATERIALS

700.10 Post Type – Posts may be wood or steel, except that:

Steel posts shall be used:

- where it is not possible to attain the required embedment for wood posts, such as where bedrock or boulders obstruct the post hole;
- on ground slopes exceeding 1.5 horizontal to 1 vertical (34°);
- in wetlands, in areas frequently under water, or in areas of soft organic soils; and
- where it is determined that wood posts are unsuitable for the existing ground conditions, topography or other environmental factors.

700.11 Wood Posts – Wood posts shall be straight peeled jack pine or lodgepole pine 4300 mm long with a minimum tip diameter of 150 mm and a maximum butt diameter of 200 mm. The bottoms of the wood posts must be tapered to a rounded end for driveability. Round wood posts shall be treated in accordance with CSA O80-97, and in particular, CSA O80.5-97 Preservative Treatment of Posts by Pressure Processes. Sawn timber posts and members shall be treated for ground contact in accordance with CSA O80-97, and in particular, CSA O80.2-97 Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes.

700.12 Preservative Treatment for Protecting Field Cut Wood and Bolt Holes – Field cuts and bolt holes shall be protected in accordance with AWPA Standard M4. The colour of the preservative treatment used for protecting field cut wood and bolt holes shall match the original preservative treatment colour, where possible.

700.13 Steel Posts – Where steel posts are located in wetlands, in areas frequently under water, or in areas of soft organic soils, they shall conform to ASTM-A-53-89a, Schedule 80, or equivalent; hot dipped galvanized to the requirements of CAN/CSA G164M Table 1. Otherwise, steel posts shall conform to ASTM-A-53-89a, Schedule 40, or equivalent; hot dipped galvanized to the requirements of CAN/CSA G164M Table 1.

The steel posts will not have an outside diameter less than 73 mm. The length of steel posts may vary between 3560 mm and 4500 mm according to installation conditions as shown on the Drawings.

Upon approval by the Ministry Representative, short steel posts may be lengthened, by a maximum of 1000 mm, by a welded extension. All welds shall be inspected by the Ministry Representative. Welds will be ground as necessary to achieve a smooth, bare metal surface and immediately covered with two coats of zinc rich coating as per SS 700.14

700.14 Touch-up Treatment for Galvanized Metal Surfaces – Touch-up treatment for damaged galvanizing of steel posts and braces shall be two coats of an organic, zinc rich paint on a thoroughly cleaned surface.

700.15 Fabric – The fence fabric will be 2.44 m (8 ft) high with 150 mm (6 in) horizontal and graduated vertical spacing, 12.5 gauge high tensile wire with a twisted friction type joint at each horizontal/vertical contact point. The fence fabric will have a minimum of 20 horizontal wires, with graduated vertical spacing ranging from 7.62 cm (3 inches) at the bottom to 17.78 cm (7 inches) at the top. The fence material will be galvanized to a retention of not less than Class 3 coating, 240 g/m^2. The horizontal wires will have a minimum tensile strength of 1234 MPa (179 ksi).

700.15.01 Fence Fabric in Confined Locations – Where space limitations do not permit the handling of the full 2.44 m (8 ft) section of fence, it will be permissible, where approved by the Ministry Representative, to use two, 1.22 m (4 ft) sections of fencing. These sections will be connected by galvanized steel compression hog rings every 150 mm or joined longitudinally with a continuous 3 mm (11 gauge) galvanized wire woven through the mesh and wrapped every 150 mm.

700.16 One-Way Gates – Gates shown on the Drawings shall be of the prefabricated type indicated on Drawings SP700-12.1 to SP700-12.6 and as specified in SS 316.11 and/or in the Special Provisions. The one-way gates must be test assembled in shop, adjusted and lubricated to swing freely without binding, and quietly shut from any position.

700.16.01 One-Way Gate Tines – Tines shall be fabricated from AISI 4140 high tensile steel to avoid animals or people bending them. Subsequent to cold-bending the tines, and prior to hot-dipped galvanizing, the material shall be heat treated and stress relieved to achieve a Rockwell C Hardness (HRC) value of 30-35. The vertical gap between sections of tines must not exceed 200 mm. The horizontal gap between the left and right sections of tines of the one-way gates must not exceed 100 mm.

All metal in one-way gates must be galvanized. Acid bath treatment of the tines prior to galvanization shall be controlled to minimize potential weakening of welds.

700.17 Lockable Human Access Gates – Gates shown on the Drawings shall be of the prefabricated type indicated on Drawings SP700-14.1 to SP700-14.2. The lockable human access gates must be adjusted and lubricated to swing and shut freely without binding in the field. Lock assemblies must be adjusted to work in the field.

700.18 Double Swing Gates – Gates shown on the Drawings shall be of the prefabricated type indicated on Drawings SP700-13.1 to SP700-13.2. The human access gates must be adjusted and lubricated to swing and shut freely without binding in the field. Lock assemblies must be adjusted to work in the field.

CONSTRUCTION

700.20 Provision of Fencing – Fencing shall be carried out at the locations and as shown on the Drawings with the materials to the height, spacing and with accessories all in accordance with the details indicated on the Drawings, Standard Specifications, and Special Provisions or to the direction of the Ministry Representative.

All material shall be supplied by the Contractor, except where supply in whole or in part by the Ministry, f.o.b. the Contractor's job site yard or Ministry's yard, is specified in the Special Provisions.

Construction shall be carried out with all labour, tools, equipment and incidentals supplied by the Contractor, as necessary, to complete all fencing work in accordance with good work practice.

700.21 Clearing & Grading – Prior to commencing fencing work, both sides of the fence line must be free of all clearing and grubbing debris. All trees, other than those required by the Ministry Representative to remain, and all brush and other obstacles which interfere with the construction and maintenance of fencing and not removed by the normal clearing operations, must be removed.

The cleared and graded area must be a minimum of 3 m wide on each side of the fence to permit access for fence repairs and maintenance, unless a lesser width is permitted by the Ministry Representative.

The ground line for the fence should be smooth and continuous for a minimum of 1 m on both sides of the fence. Minor ground undulations shall be corrected to obtain a smooth uniform grade, but appreciable grade depressions may be backfilled only with the permission of the Ministry Representative.

The site shall be left in a smooth and tidy condition.

700.22 Setting Out and Connections to Existing Fences – Fence line, as shown on the Drawings, generally will be located a minimum of 3 m from the right-of-way boundary, unless a lesser distance is permitted by the Ministry Representative.

In areas of heavy snow, where the 10 year average total annual snowfall is greater than 2 m, as identified in Special Provisions, the fence line must be offset a minimum of 4 m from the edge of the highway shoulder to reduce damage from snowplows. Otherwise, the fence line must be offset a minimum of 3 m from the edge of the highway shoulder.

Post installation in fill material or minimum overburden shall be carried out according to the Ministry Representative's directions. Where it is not possible to drive or set wood posts to proper depth or to relocate same along the fence line, steel fence posts as specified or, where permitted, multiple wood post and brace assemblies shall be substituted.

Existing fences shall be connected to new fences with posts and braces for tensioning fencing wire in every direction in accordance with the SP700 series of Drawings.

700.23 Post Spacing – Unless specified otherwise in Special Provisions, line posts shall be spaced 5 m apart measured horizontally. It will be permissible to move a post up to 0.3 m ahead or back along the fence line to avoid an obstruction preventing advancement of the post hole, provided that the average spacing does not exceed 5 m.

In areas of heavy snow, where the 10-year average total annual snowfall is greater than 2 m, as identified in Special Provisions, the line post spacing must be reduced to 3.5 m to reduce fence fabric sagging and tearing.

700.23.01 Installation of Wood Posts -Wood posts shall be installed plumb and to a depth of 1500 mm, as indicated on the Drawings. Posts may be either driven or set in excavated holes, provided that a rigid installation is achieved, capable of withstanding a horizontal load of 32 kg (70 lb), applied 1.5 m above the ground, in any direction in the horizontal plane, without any movement in excess of 25 mm. When a wood post is set in an excavated hole, the soil around the wood post must be compacted to the satisfaction of the Ministry Representative. The horizontal load test must be conducted after the post is installed but before the fabric wire is attached. It is the responsibility of the Contractor to conduct and record the horizontal load test. The results of the horizontal load test must be submitted to the Ministry Representative.

Where the slope of the terrain along the fence line approaches 1.5:1 (34°), embedment of wood posts may be reduced to a minimum of 1200 mm, with permission of the Ministry Representative. Where fence gradients exceed 1.5:1 (34°), steel posts must be used, as indicated on the Drawings.

No cutting of pressure treated wood posts will be permitted without authorization of the Ministry Representative. When cutting is authorized, the cut must be only at the top of the post. All cuts must be resealed immediately with a preservative, conforming to CSA O80, having properties equal to or superior to the original pressure treatment solution and of a similar colour.

700.23.02 Installation of Steel Posts – Steel line posts, end posts, corner posts and brace posts embedded in solid rock shall be set in concrete or non-shrink grout.

Where bedrock is encountered on steep slopes at depths less than 1200 mm, the total embedment length may be reduced to 1000 mm. Of the 1000 mm, a minimum of 200 mm shall be set into the bedrock with the remainder set in concrete footings not less than 350 mm in diameter. The top surface of all concrete footings shall be a minimum of 25 mm above ground and slope away from the post to provide positive drainage as indicated on the Drawings.

Steel posts will be installed plumb and to the specified depth, as indicated on the Drawings. Notwithstanding, anything to the contrary in the steel post embedment details shown on the Drawings, any part of the post embedment that is excavated will be backfilled entirely with well-compacted concrete conforming to Class Y of SS 218 Table 218-A.

Steel posts set in organic or other soft soils shall have a total embedment length of 1800 mm. If the post is driven, the top 800 mm will be set in a concrete footing with a minimum diameter of 350 mm.

Steel corner posts or brace panel posts in soft ground will also have an embedment length of 1800 mm. If the post is driven, the top 1250 mm will be set in concrete footings with a minimum diameter of 350 mm.

Any cut or abraded steel posts must be painted immediately with metal primer paint to inhibit corrosion, according to SS 700.14. Any damage to galvanized coatings must be repaired according to SS 700.14.

Steel posts will be installed with galvanized steel post caps.

Steel posts will be set to provide a rigid installation capable of withstanding a horizontal load of 32 kg (70 lb), applied 1.5 m above the ground, in any direction in the horizontal plane, without any movement in excess of 25 mm. The horizontal load test must be conducted after the post is installed but before the fabric wire is attached. It is the responsibility of the Contractor to conduct and record the horizontal load test. The results of the horizontal load test must be submitted to the Ministry Representative.

700.24 Fence Ties – Fencing shall be tied into structures, gates and existing fencing as staked in the field or as directed by the Ministry Representative. Fencing ties will at no time leave a gap greater than 100 mm.

Care must be taken to ensure that the fencing ties and post installation does not compromise the effectiveness of the adjacent structures.

At bridges, posts may be wood or steel as permitted by the Ministry representative. Where steel posts are used, steel posts shall be bolted to the concrete abutments using Hilti fasteners or an acceptable equivalent. Where wood posts are used, wood posts shall be located as close to the abutments as possible.

At ungulate guards, steel posts will be bolted into the concrete abutments using Hilti fasteners or an acceptable equivalent, wood posts shall be located as close to the ungulate guard abutments as possible.

700.25 Brace Panels – Brace panels will include intermediate brace panels, double intermediate brace

panels consisting of two intermediate brace panels back to back and end post panels.

Brace panels shall be constructed and installed as shown on the Drawings SP700-01 to SP700-02. Cross wires shall be twisted to provide suitable tension, in the manner illustrated on the Drawing SP700-01.

Bracing wire must be galvanized and a minimum of 9 gauge.

The spacing between adjacent intermediate brace panels, and between intermediate brace panels and end post panels, will not be more than 54 m, unless otherwise permitted by the Ministry Representative.

Intermediate brace panels shall be installed where necessary to meet the foregoing requirement, and also where required by the Ministry representative at changes in vertical or horizontal alignment.

Double brace panels will be used at corners and other sharp changes in the vertical or horizontal alignment, and at any other locations where they are, in the judgement of the Ministry Representative, required to maintain the integrity of the fence.

End post panels will be installed where the fence ties in to structures or gates, at ungulate guards and at any other termination of the fence. The requirement for brace panels at one-way wildlife gates is shown on Drawing SP700-12.1.

700.26 Fence Fabric Installation – The fence fabric will be fastened to posts on the surface facing away from the highway right-of-way, except where the fence is located adjacent to concrete barriers and overpasses.

For wood posts, the wire fence fabric shall be stapled to each post, using a maximum vertical spacing of 150 mm including both the top and bottom wires. Staples will be barbed and galvanized steel, 3.5 mm in diameter with a driven length of at least 50 mm.

The fence fabric will be attached to steel posts with a minimum of four (4) galvanized muffler clamps (e.g. MC12300 P type); one on the top strand, one 0.60 m below the top strand, one 1.20 m below the top strand, and one on the bottom wire of the fence fabric. Intermediate connections will be made every 300 mm along the post with 3.5 mm galvanized wire twisted to form a tight connection.

The wire fence fabric shall be tensioned to provide a uniform pull in order to minimize distortion of the fabric. Each run of fence fabric between brace panels will be tensioned before staples are set or clamps tightened.

The tension of the fence fabric will be considered adequate when the fabric cannot be pulled more than 100 mm out of line with a 13.6 kg (30 lb) pull at any point from top to bottom between the posts. The allowable 100 mm will include any deflection of the post, should this occur.

The fence fabric will be as close to the ground as possible, but in any case, the vertical distance between the bottom strand of wire and the existing ground will nowhere exceed150 mm. Unerodible, clean fill material, neatly trimmed, will be added to obtain this clearance, where practical.

Where the fence crosses gullies or drainage channels, a specially fabricated section of fence will be cut to fit the opening and will be fastened to the bottom wire and the streambed as shown on the Drawings. Alternatively, but only where required by the Ministry Representative, culvert pipe will be installed at specific crossings in accordance with the Special Provisions.

700.27 Connection Treatments at Structures – Fences must be securely attached to walls, abutments, ungulate guards and other structures to ensure stability of the fences and to prevent animals from passing between the fence and the structure. The fence must be attached as per SP700-11 using rock bolts as per SS 206.

700.28 Gates – Hardware shall be securely attached to permit the gate to open correctly and prevent the easy removal of the gate and hardware. Hinges shall be installed to permit the gate to swing back one-way against the fence. Locking hardware shall be of the type specified in Drawing SP700-13.2.

700.29 Lockable Human Access Gates – Access must be provided to allow inspection access from the highway of all points of all bridges, both ends of culverts greater than 2 m in diameter, retaining walls over 2 m in height, tunnels, and farm and wildlife crossing structures.

Lockable human access gates must be located where they can be safely used, avoiding cliffs, steep slopes, swamps, areas frequently under water, and where unstable ground conditions exist. The gates must be located within 25 m of the structures and culverts they provide access to, unless a greater distance is permitted by the Ministry Representative. The gates shall be of the type specified in Drawing SP700-14.1.

Unless otherwise permitted by the Ministry Representative, the minimum number of lockable human gates required is:

a) Culverts greater than 2 m in diameter: 1 gate for each fence located adjacent to the culvert
b) Retaining walls greater than 2 m in height:
   Retaining walls less than 200 m long: 1 gate where the wildlife exclusion fencing abuts the wall
   Retaining walls greater than 200 m long: 1 gate at each location of the wall where the wildlife exclusion fencing abuts the wall
c) Tunnels: 1 gate at each tunnel portal
d) Bridges: 1 gate for each location where the wildlife exclusion fencing abuts a bridge. The total number of gates required for a bridge may be reduced by the Ministry Representative if sufficient access, during median flow of water conditions, can be provided and maintained with fewer gates.

QUALITY ASSURANCE

700.30 Quality Assurance – The Ministry Representative must be provided a reasonable opportunity to conduct acceptance testing in conformance with SS 700, SS 741, SS 218, SS 909, and SS 316.

The Contractor will disassemble and relocate any elements of the fence necessary for testing at the discretion of the Ministry Representative. If the test of an element is successful, the Ministry shall pay all costs for the replacement of the materials and reconstruction of the element tested.

The Ministry Representative may require any element not tested, or failing the test, to be replaced and retested.

When the Ministry Representative requests a test of an element of the fence and the test fails, all costs will be to the Contractor's account, including the replacement of the materials and reconstruction of the element tested, and all costs associated with the retesting.

700.30.01 Removal and Replacement at Contractor's Expense – The Ministry Representative may require any fencing materials that do not meet the Ministry's specifications to be removed and replaced at the Contractor's expense.

The Ministry Representative may require any constructed fencing or gates that do not meet the Ministry's specifications to be removed and replaced at the Contractor's expense.

MEASUREMENT

700.40 Fencing – Fencing will be measured by the LINEAL METRE. Measurements will be made parallel to the top wire of complete fencing, including any tensioning assemblies, but excluding gate openings.

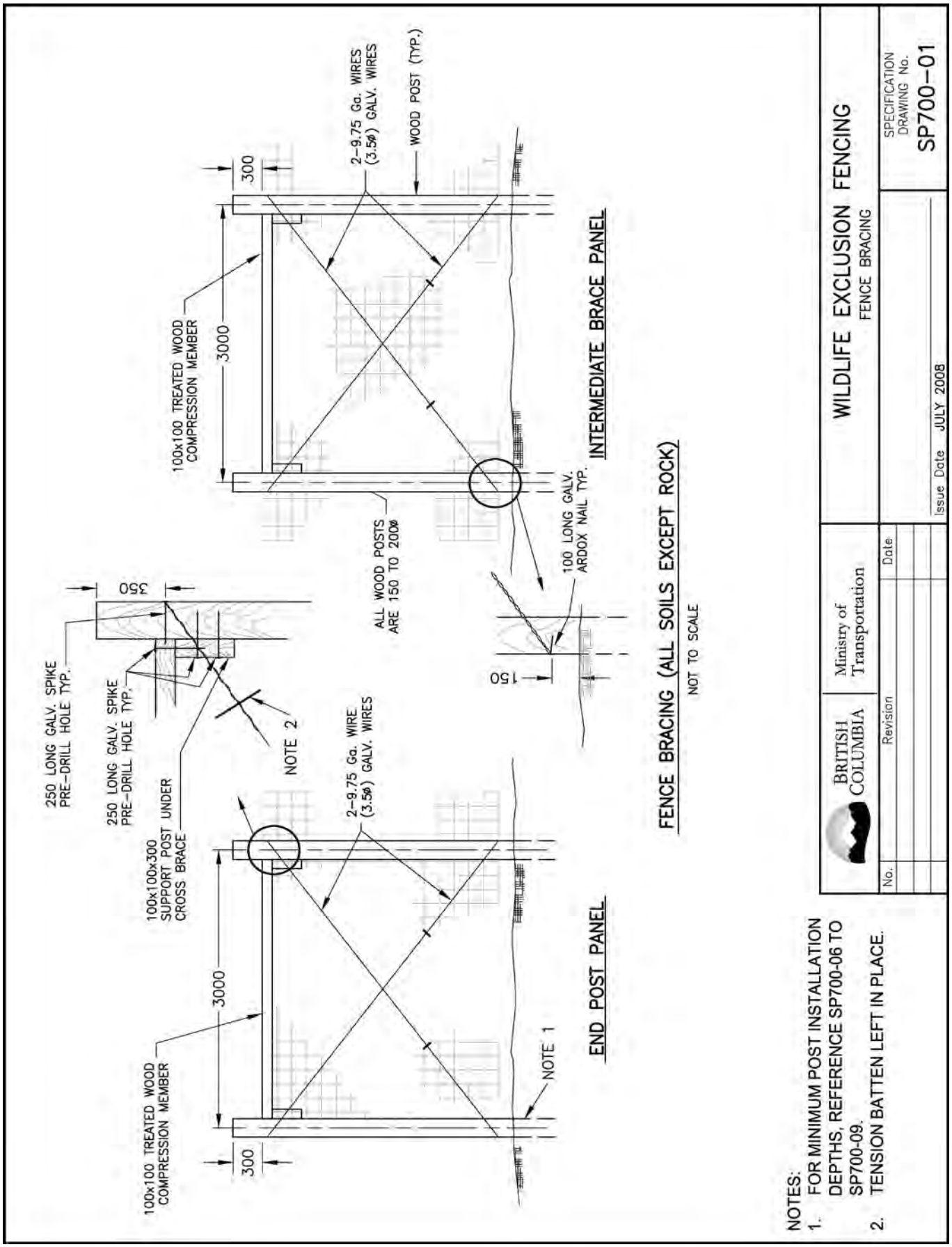
700.41 One-Way Gates, Lockable Human Access Gates and Double Swing Gates – Gates will be measured by the unit for EACH type and size furnished and/or installed complete in place.

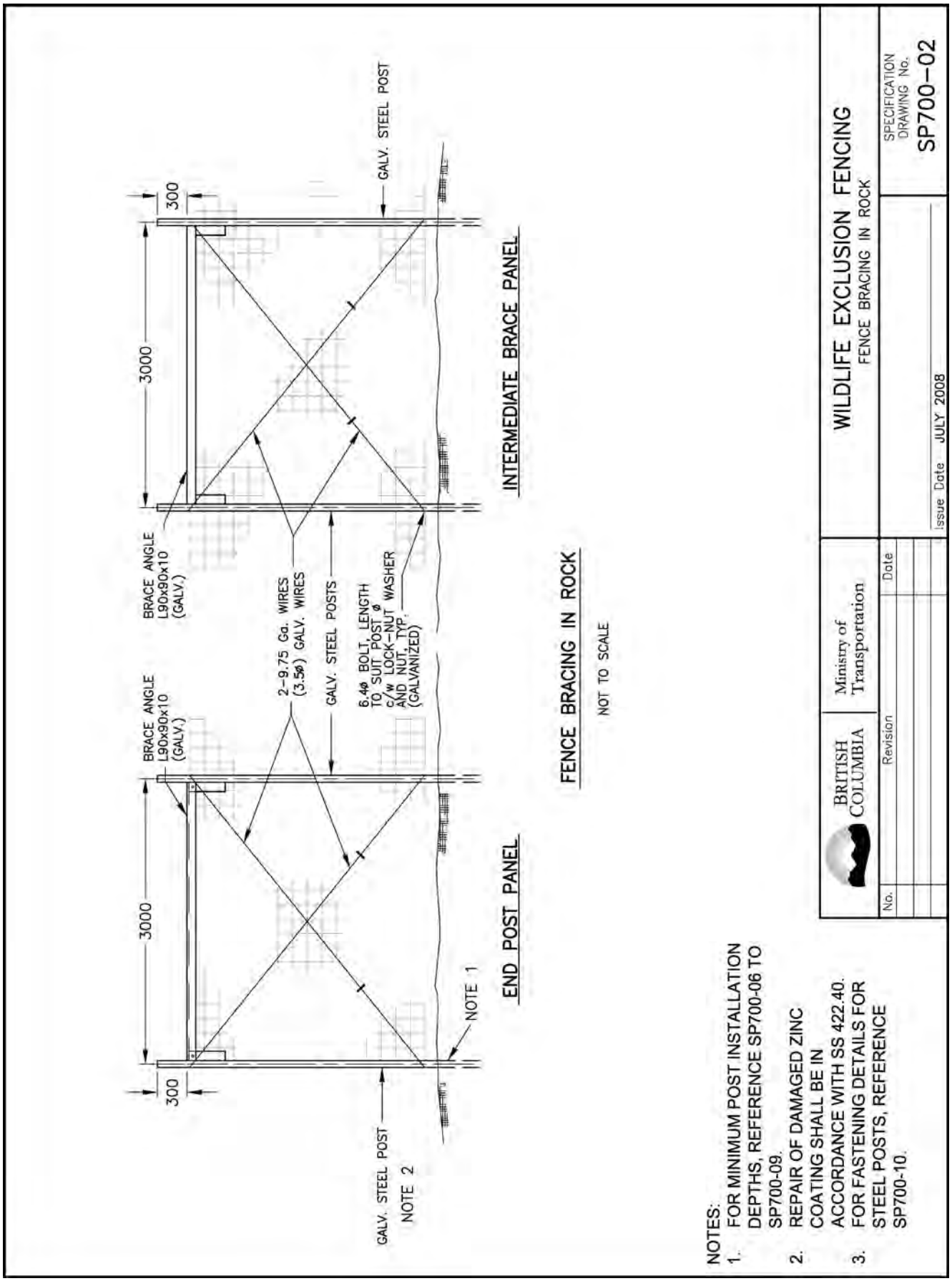
PAYMENT

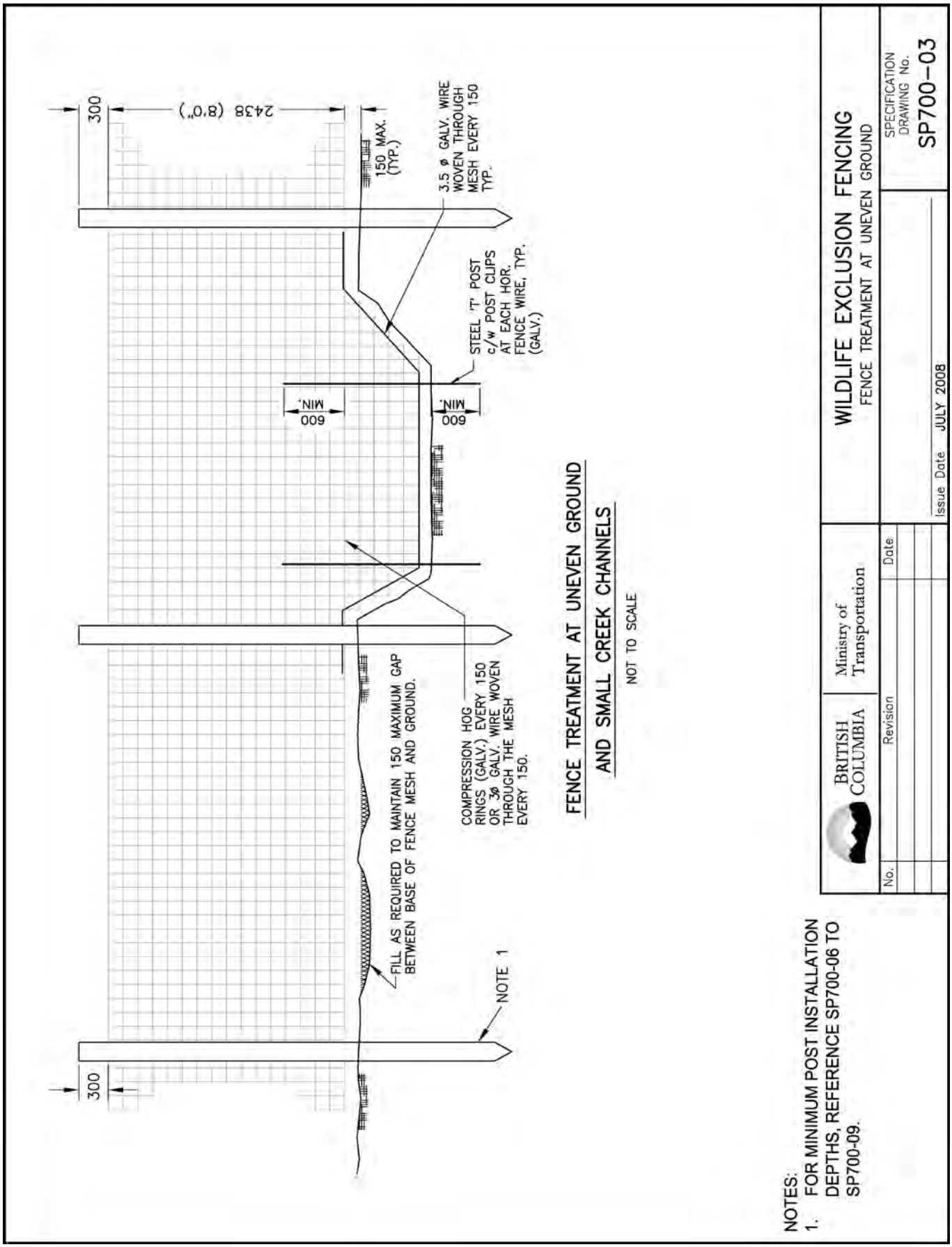
700.50 Fencing – Payment for FENCING, meeting the requirements as specified to the satisfaction of the Ministry Representative, will be at the Contract Unit Price per lineal metre of complete fencing, including any tensioning assemblies, but excluding one-way gates, lockable human access gates, double swing gates.

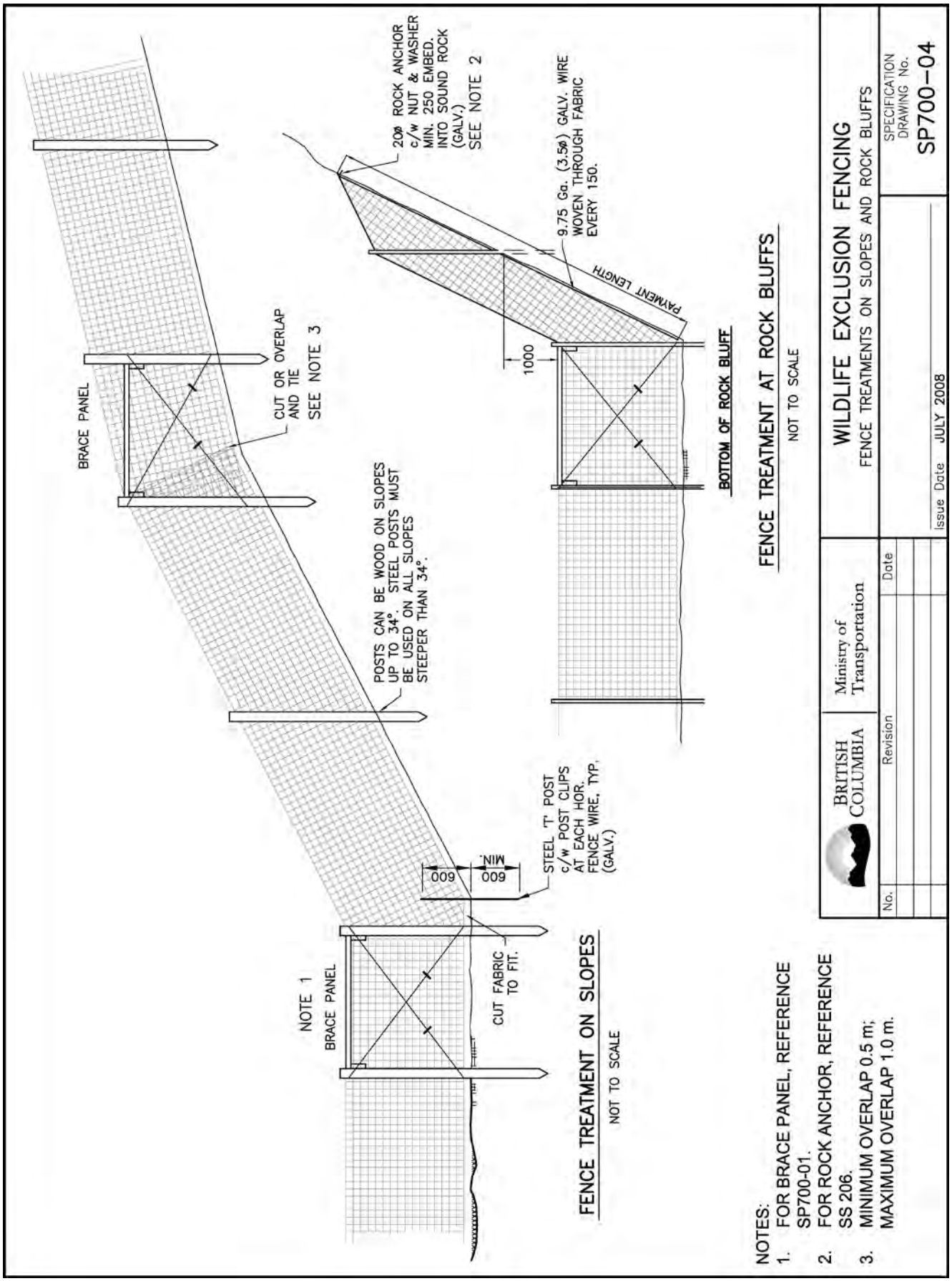
The Contract Unit Price(s) shall be accepted as full compensation for furnishing all material and/or taking delivery of Ministry supplied material; as and where noted, all labour, tools, equipment and incidentals to complete the required installation, including the clearing of any additional right of way, construction of temporary fencing, connection to existing fences and/or structures, and final clean up.

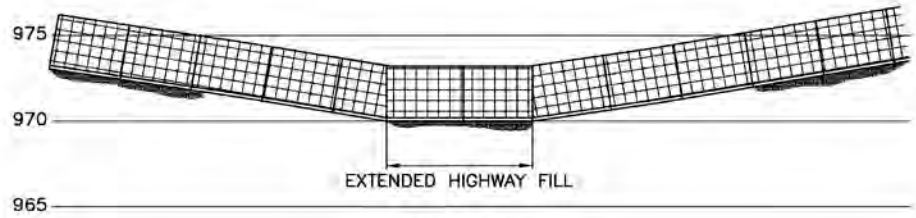
700.51 Gates – Payment for ONE-WAY GATES, LOCKABLE HUMAN ACCESS GATES, DOUBLE SWING GATES, meeting the requirements as specified to the satisfaction of the Ministry Representative, will be at the Contract Unit Price for each type and size furnished and/or installed complete in place.


WILDLIFE EXCLUSION FENCING
FENCE BRACING
SPECIFICATION DRAWING No.
SP700-01
Issue Date JULY 2008
BRITISH COLUMBIA
Ministry of Transportation
No.
Revision
Date
INTERMEDIATE BRACE PANEL
END POST PANEL
FENCE BRACING (ALL SOILS EXCEPT ROCK)
NOT TO SCALE
100x100 TREATED WOOD COMPRESSION MEMBER
3000
300
2-9.75 Ga. WIRES (3.5ø) GALV. WIRES
WOOD POST (TYP.)
ALL WOOD POSTS ARE 150 TO 200ø
100 LONG GALV. ARDOX NAIL TYP.
150
350
250 LONG GALV. SPIKE PRE-DRILL HOLE TYP.
250 LONG GALV. SPIKE PRE-DRILL HOLE TYP.
100x100x300 SUPPORT POST UNDER CROSS BRACE
NOTE 2
2-9.75 Ga. WIRE (3.5ø) GALV. WIRES
NOTE 1
NOTES:
1. FOR MINIMUM POST INSTALLATION DEPTHS, REFERENCE SP700-06 TO SP700-09.
2. TENSION BATTEN LEFT IN PLACE.

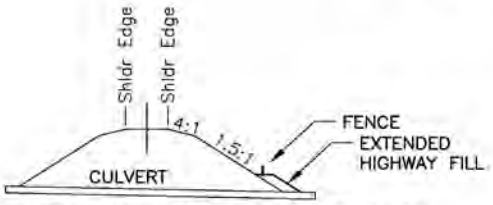

END POST PANEL
INTERMEDIATE BRACE PANEL
FENCE BRACING IN ROCK
NOT TO SCALE
3000
300
BRACE ANGLE L90x90x10 (GALV.)
2-9.75 Ga. WIRES (3.5ø) GALV. WIRES
GALV. STEEL POSTS
6.4ø BOLT, LENGTH TO SUIT POST ø C/W LOCK-NUT WASHER AND NUT, TYP. (GALVANIZED)
GALV. STEEL POST
NOTE 1
NOTE 2
NOTES:
1. FOR MINIMUM POST INSTALLATION DEPTHS, REFERENCE SP700-06 TO SP700-09.
2. REPAIR OF DAMAGED ZINC COATING SHALL BE IN ACCORDANCE WITH SS 422.40.
3. FOR FASTENING DETAILS FOR STEEL POSTS, REFERENCE SP700-10.
BRITISH COLUMBIA
Ministry of Transportation
No.
Revision
Date
WILDLIFE EXCLUSION FENCING
FENCE BRACING IN ROCK
Issue Date JULY 2008
SPECIFICATION DRAWING No.
SP700-02


300
2438 (8'0")
150 MAX. (TYP.)
3.5 ø GALV. WIRE WOVEN THROUGH MESH EVERY 150 TYP.
STEEL 'T' POST c/w POST CLIPS AT EACH HOR. FENCE WIRE, TYP. (GALV.)
600 MIN.
600 MIN.
FILL AS REQUIRED TO MAINTAIN 150 MAXIMUM GAP BETWEEN BASE OF FENCE MESH AND GROUND.
COMPRESSION HOG RINGS (GALV.) EVERY 150 OR 3ø GALV. WIRE WOVEN THROUGH THE MESH EVERY 150.
NOTE 1
300
FENCE TREATMENT AT UNEVEN GROUND
AND SMALL CREEK CHANNELS
NOT TO SCALE
NOTES:
1. FOR MINIMUM POST INSTALLATION DEPTHS, REFERENCE SP700-06 TO SP700-09.
BRITISH COLUMBIA
Ministry of Transportation
No. Revision Date
WILDLIFE EXCLUSION FENCING
FENCE TREATMENT AT UNEVEN GROUND
Issue Date JULY 2008
SPECIFICATION DRAWING No.
SP700-03


20ø ROCK ANCHOR c/w NUT & WASHER MIN. 250 EMBED. INTO SOUND ROCK (GALV.) SEE NOTE 2
9.75 Ga. (3.5ø) GALV. WIRE WOVEN THROUGH FABRIC EVERY 150.
PAYMENT LENGTH
1000
BOTTOM OF ROCK BLUFF
FENCE TREATMENT AT ROCK BLUFFS
NOT TO SCALE
BRACE PANEL
CUT OR OVERLAP AND TIE SEE NOTE 3
POSTS CAN BE WOOD ON SLOPES UP TO 34°. STEEL POSTS MUST BE USED ON ALL SLOPES STEEPER THAN 34°.
STEEL 'T' POST c/w POST CLIPS AT EACH HOR. FENCE WIRE, TYP. (GALV.)
600
MIN.
600
NOTE 1
BRACE PANEL
CUT FABRIC TO FIT.
FENCE TREATMENT ON SLOPES
NOT TO SCALE
NOTES:
1. FOR BRACE PANEL, REFERENCE SP700-01.
2. FOR ROCK ANCHOR, REFERENCE SS 206.
3. MINIMUM OVERLAP 0.5 m; MAXIMUM OVERLAP 1.0 m.
BRITISH COLUMBIA
Ministry of Transportation
No.
Revision
Date
WILDLIFE EXCLUSION FENCING
FENCE TREATMENTS ON SLOPES AND ROCK BLUFFS
Issue Date JULY 2008
SPECIFICATION DRAWING No.
SP700-04

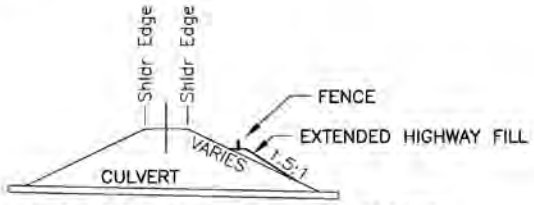


PROFILE
A–A
(ALONG FENCE LINE)



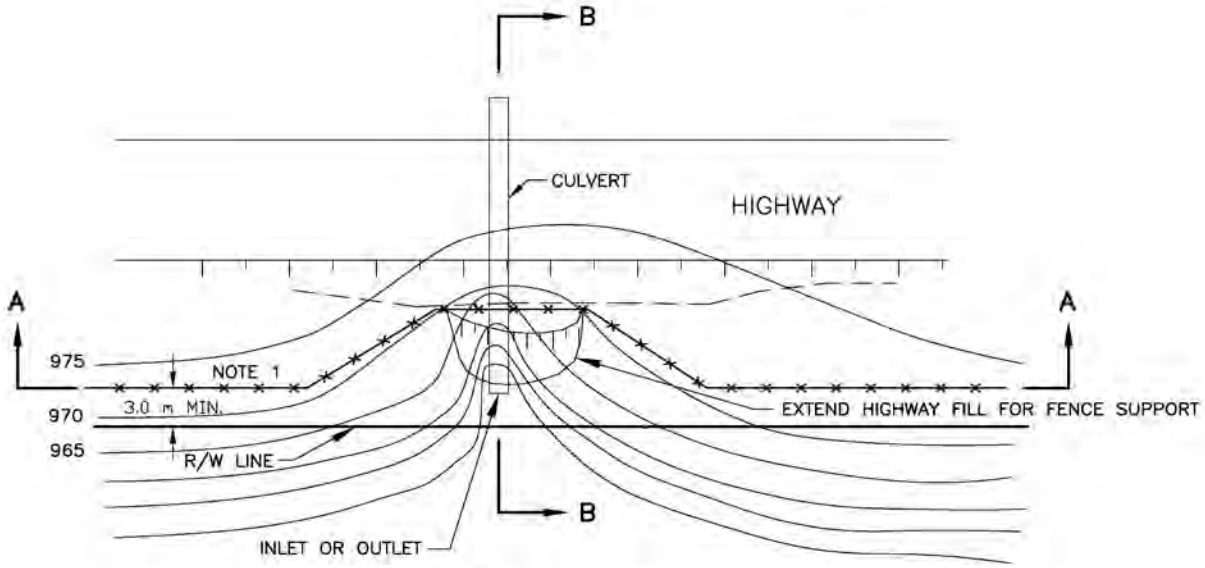
INSTALLATION ON NEW HIGHWAY CONSTRUCTION

SECTION
B–B



INSTALLATION ON EXISTING HIGHWAY FILL SLOPES

SECTION
B–B



PLAN

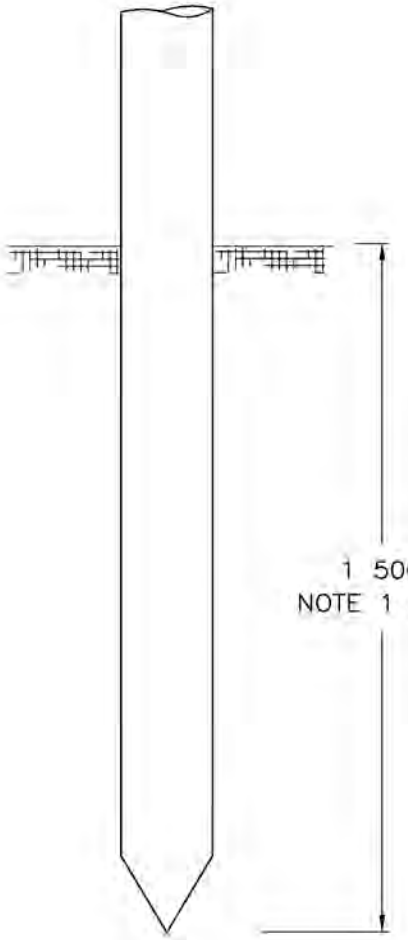
FENCE TREATMENT AT LARGE GULLIES

NOTES:
1. FENCE TO BE CONSTRUCTED INSIDE THE RIGHT-OF-WAY LINE AND MUST BE OUTSIDE OF THE HIGHWAY CLEAR ZONE (9.0 m MINIMUM)
2. LOCKABLE HUMAN ACCESS GATE MUST BE PROVIDED WITHIN 25m OF CULVERTS THAT ARE GREATER THAN 2m IN DIAMETER.

BRITISH COLUMBIA / Ministry of Transportation	WILDLIFE EXCLUSION FENCING FENCE TREATMENTS AT LARGE GULLIES	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–05

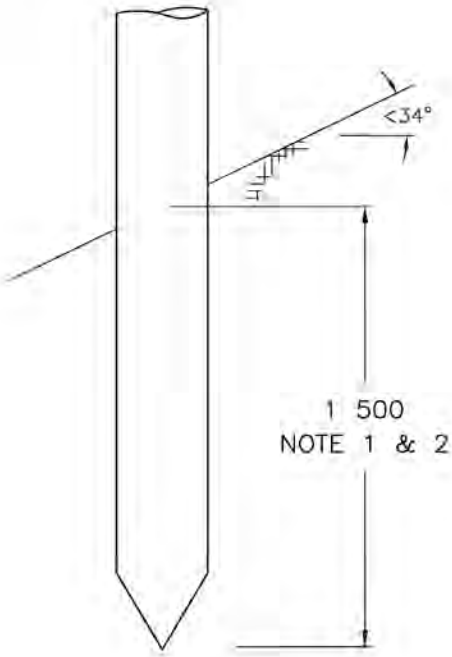
LEVEL GROUND

- ALL POSTS



SLOPES LESS THAN 34°

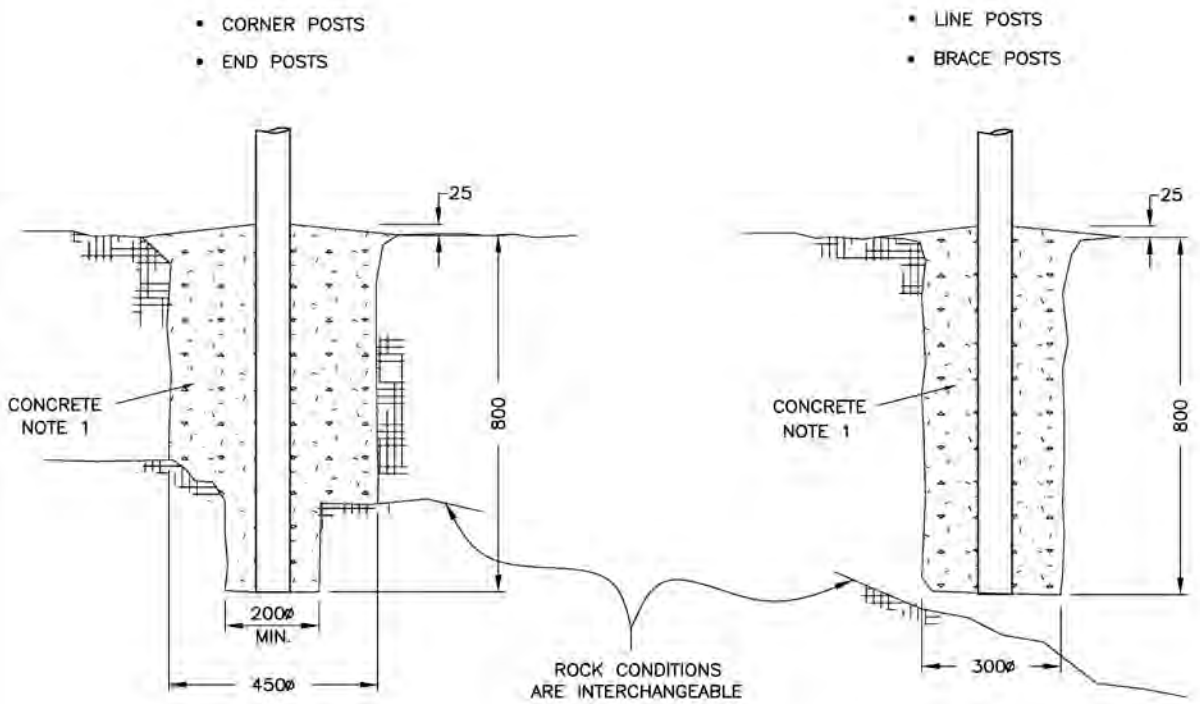
- ALL POSTS



FENCING IN EARTH
(WOOD POSTS)

NOTES:
1. 1500 mm MINIMUM PROVIDED THAT IT MEETS THE REQUIREMENTS OF THE HORIZONTAL LOAD TEST
2. WHENEVER THE REQUIREMENTS OF THE HORIZONTAL LOAD TEST CANNOT BE MET FOR WOOD POSTS, STEEL POSTS SHALL BE USED WHEN DIRECTED BY THE MINISTRY REPRESENTATIVE

BRITISH COLUMBIA / Ministry of Transportation	WILDLIFE EXCLUSION FENCING EMBEDMENT DETAILS FOR WOOD POSTS IN EARTH	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–06



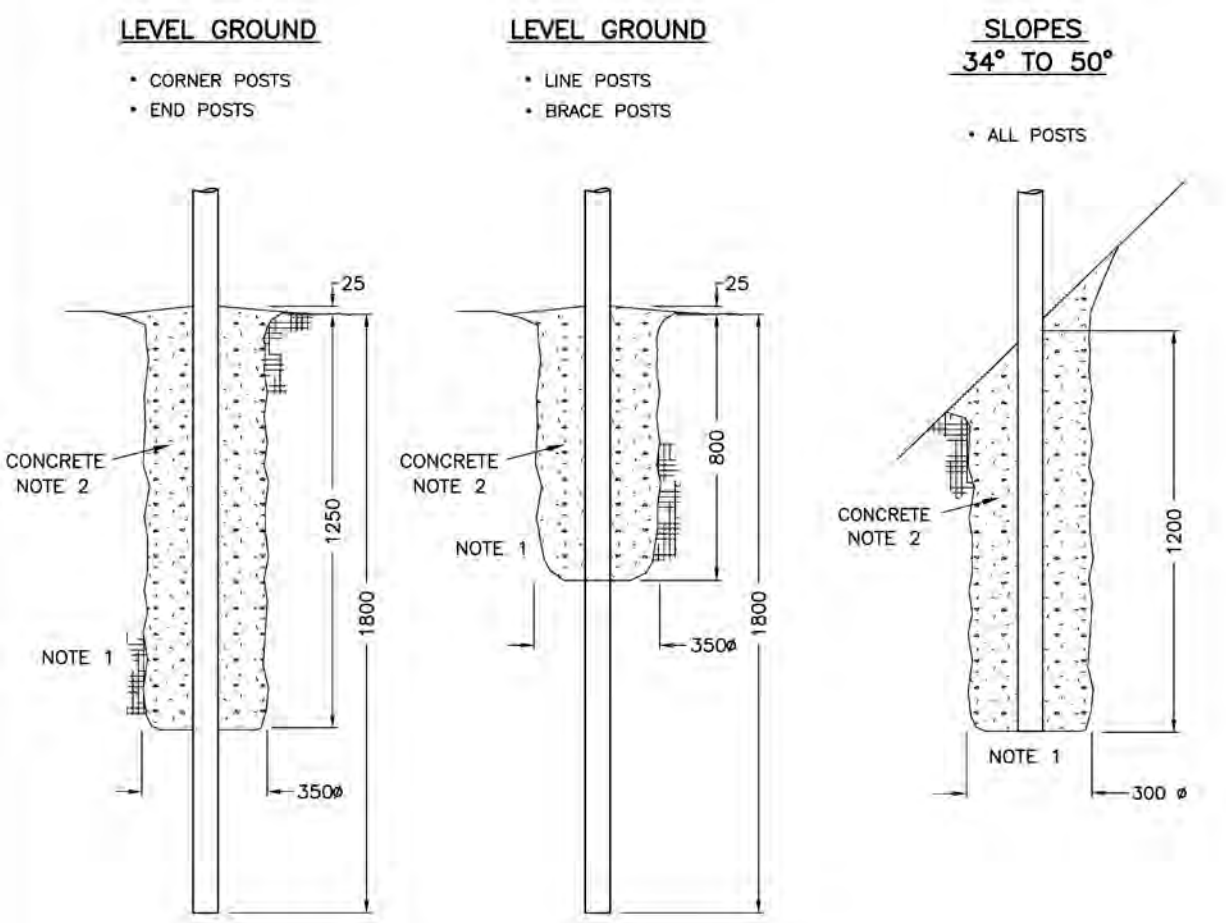
GALVANIZED STEEL POSTS IN ORGANIC MATERIAL OR COMBINATION OF ROCK AND ORGANIC MATERIAL

EMBEDMENT DETAILS

NOT TO SCALE

NOTES:
1. CONCRETE SHALL CONFORM TO SS 218, CLASS C (20mm COARSE AGGREGATE).

BRITISH COLUMBIA / Ministry of Transportation	WILDLIFE EXCLUSION FENCING EMBEDMENT DETAILS FOR FENCING IN EARTH	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–07



FENCING IN SOFT ORGANIC SOILS OR WETLANDS
(AS DIRECTED BY MINISTRY REPRESENTATIVE)

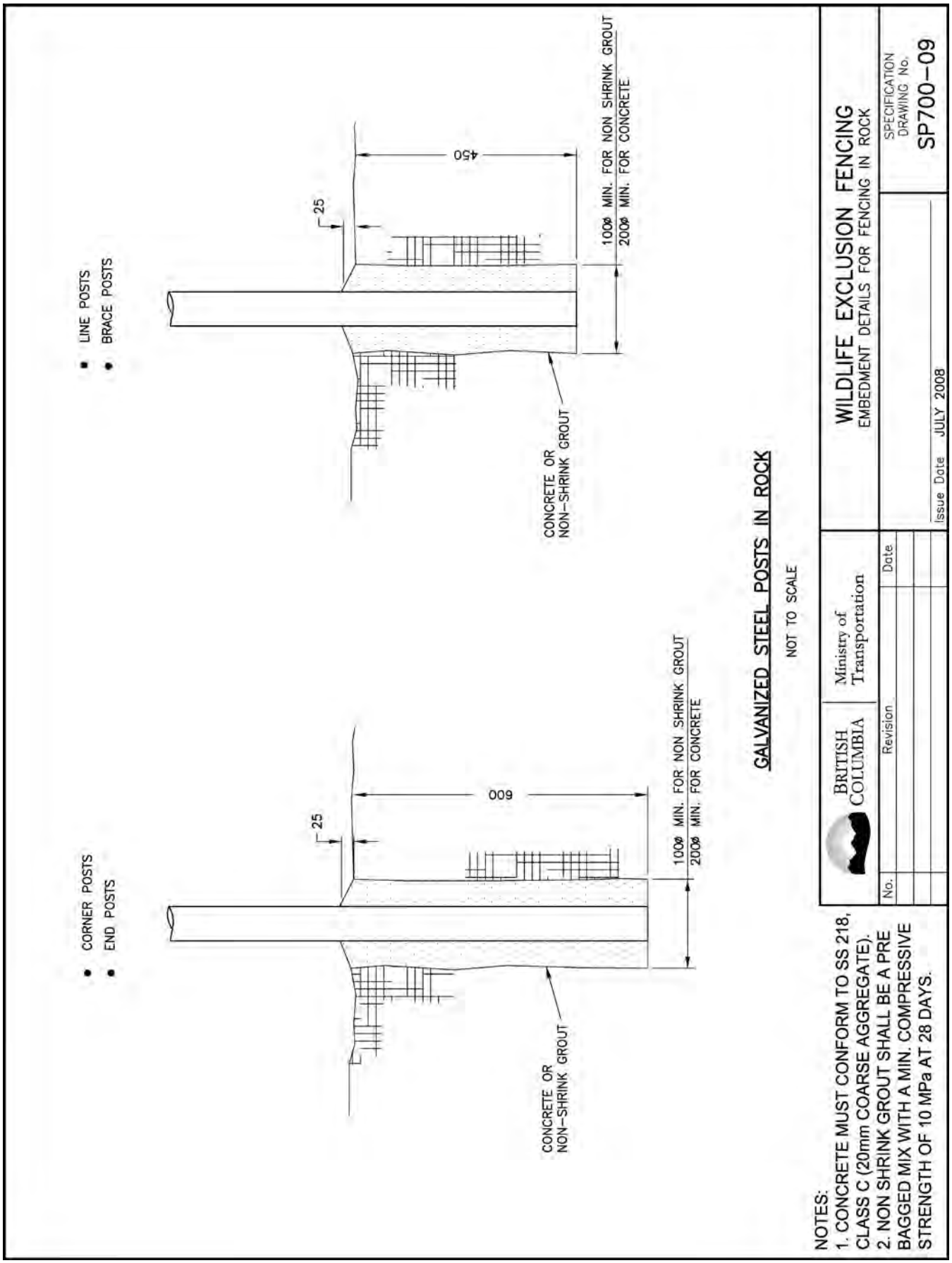
GALVANIZED STEEL POSTS

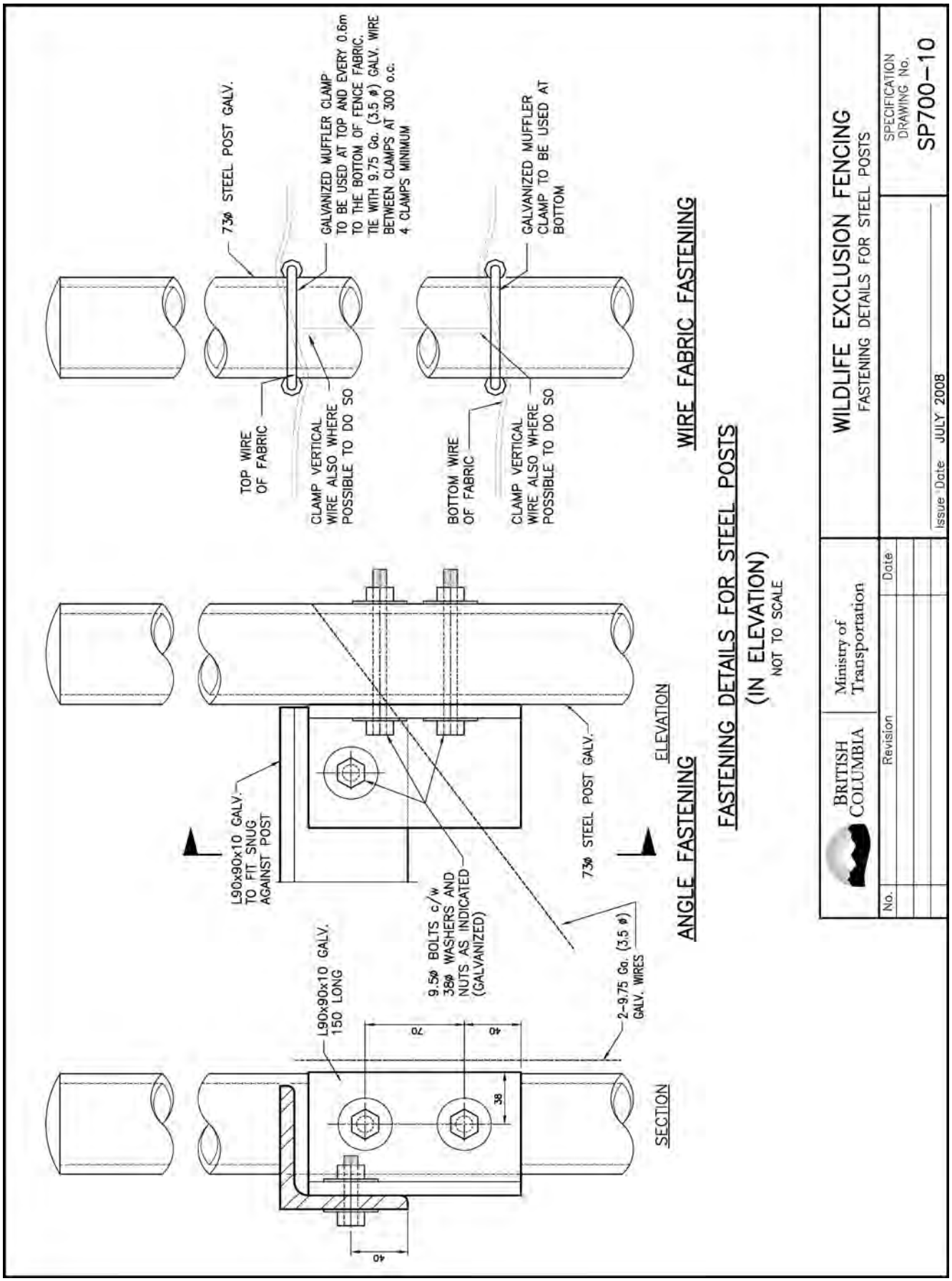
EMBEDMENT DETAILS

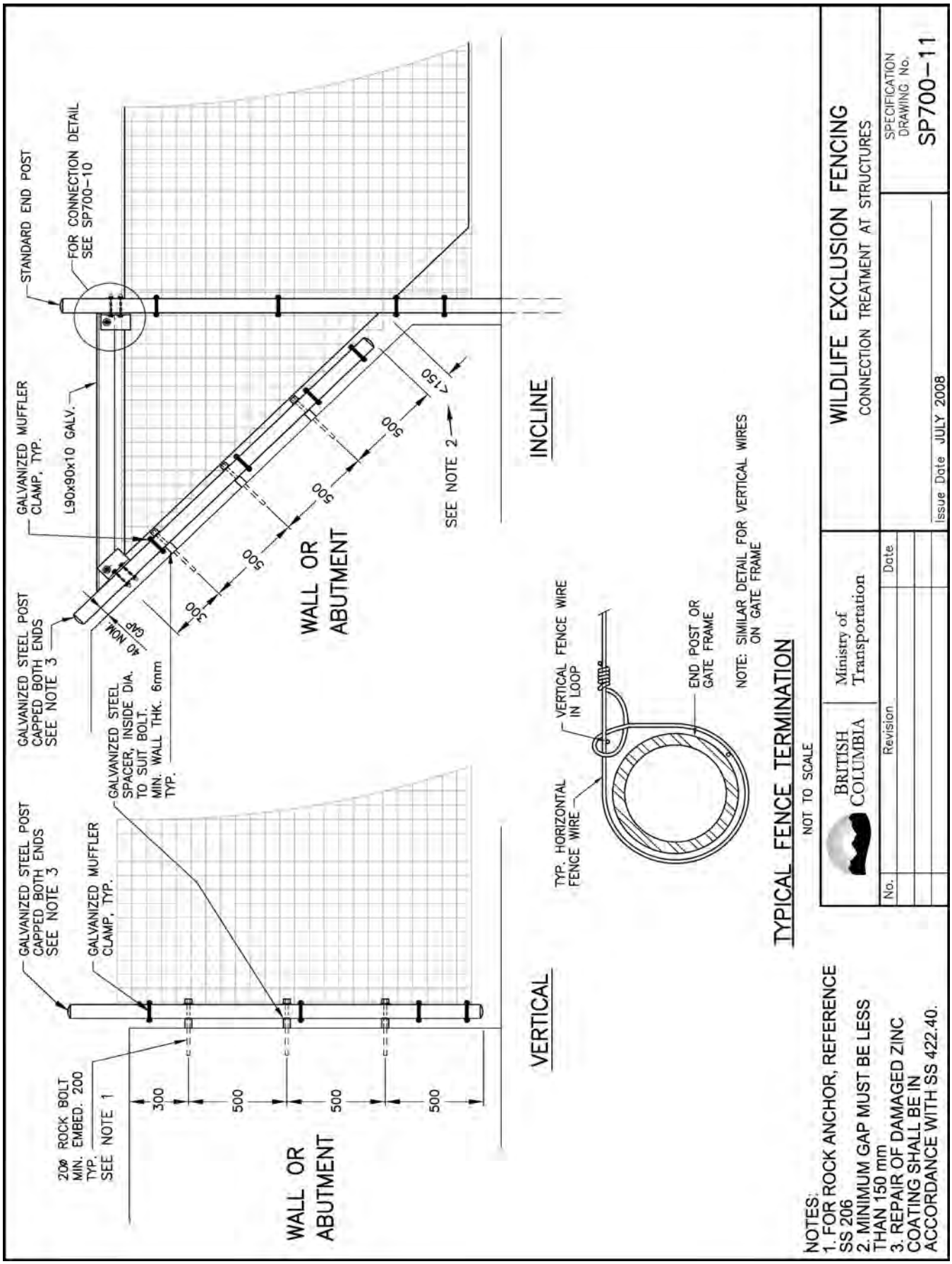
NOT TO SCALE

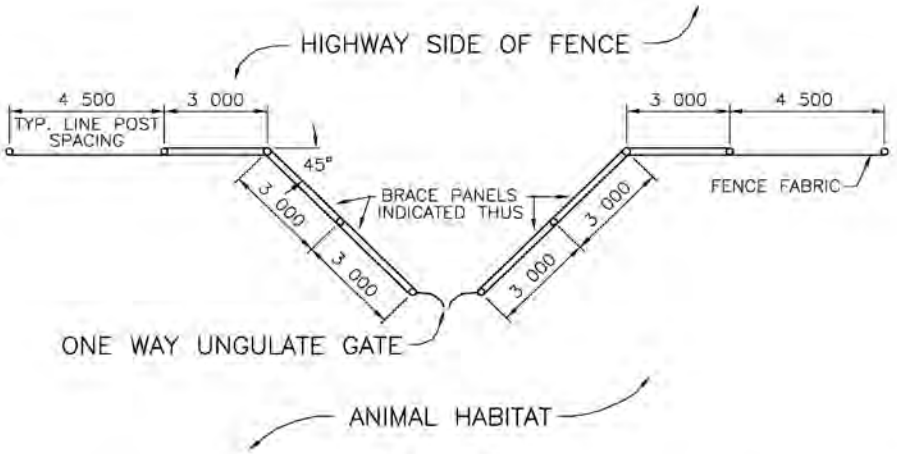
NOTE:
1. OVERSIZED HOLES SHALL BE COMPLETELY BACKFILLED WITH CONCRETE OR WELL TAMPED GRAVEL AROUND CONCRETE FOOTING.
2. CONCRETE MUST CONFORM TO SS 218, CLASS C (20mm COARSE AGGREGATE).

BRITISH COLUMBIA / Ministry of Transportation	WILDLIFE EXCLUSION FENCING EMBEDMENT DETAILS FOR SOFT ORGANIC SOILS OR WETLANDS	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–08


LINE POSTS
BRACE POSTS
CORNER POSTS
END POSTS
25
450
600
100ø MIN. FOR NON SHRINK GROUT
200ø MIN. FOR CONCRETE
CONCRETE OR NON-SHRINK GROUT
GALVANIZED STEEL POSTS IN ROCK
NOT TO SCALE
NOTES:
1. CONCRETE MUST CONFORM TO SS 218, CLASS C (20mm COARSE AGGREGATE).
2. NON SHRINK GROUT SHALL BE A PRE BAGGED MIX WITH A MIN. COMPRESSIVE STRENGTH OF 10 MPa AT 28 DAYS.
BRITISH COLUMBIA
Ministry of Transportation
No.
Revision
Date
WILDLIFE EXCLUSION FENCING
EMBEDMENT DETAILS FOR FENCING IN ROCK
Issue Date JULY 2008
SPECIFICATION DRAWING No.
SP700-09


WILDLIFE EXCLUSION FENCING
FASTENING DETAILS FOR STEEL POSTS
BRITISH COLUMBIA
Ministry of Transportation
No.
Revision
Date
SPECIFICATION DRAWING No.
SP700-10
Issue Date JULY 2008
FASTENING DETAILS FOR STEEL POSTS
(IN ELEVATION)
NOT TO SCALE
WIRE FABRIC FASTENING
73ø STEEL POST GALV.
GALVANIZED MUFFLER CLAMP TO BE USED AT TOP AND EVERY 0.6m TO THE BOTTOM OF FENCE FABRIC. TIE WITH 9.75 Ga. (3.5 ø) GALV. WIRE BETWEEN CLAMPS AT 300 o.c. 4 CLAMPS MINIMUM
TOP WIRE OF FABRIC
CLAMP VERTICAL WIRE ALSO WHERE POSSIBLE TO DO SO
GALVANIZED MUFFLER CLAMP TO BE USED AT BOTTOM
BOTTOM WIRE OF FABRIC
CLAMP VERTICAL WIRE ALSO WHERE POSSIBLE TO DO SO
ANGLE FASTENING
ELEVATION
L90x90x10 GALV. TO FIT SNUG AGAINST POST
9.5ø BOLTS c/w 38ø WASHERS AND NUTS AS INDICATED (GALVANIZED)
73ø STEEL POST GALV.
2-9.75 Ga. (3.5 ø) GALV. WIRES
SECTION
L90x90x10 GALV. 150 LONG
70
40
38
40


STANDARD END POST
FOR CONNECTION DETAIL SEE SP700-10
GALVANIZED MUFFLER CLAMP, TYP.
L90x90x10 GALV.
GALVANIZED STEEL POST CAPPED BOTH ENDS SEE NOTE 3
GALVANIZED STEEL SPACER, INSIDE DIA. TO SUIT BOLT. MIN. WALL THK. 6mm TYP.
40 NOM. GAP
300
500
500
500
150
SEE NOTE 2
WALL OR ABUTMENT
INCLINE
GALVANIZED STEEL POST CAPPED BOTH ENDS SEE NOTE 3
GALVANIZED MUFFLER CLAMP, TYP.
20ø ROCK BOLT MIN. EMBED. 200 TYP. SEE NOTE 1
300
500
500
500
WALL OR ABUTMENT
VERTICAL
VERTICAL FENCE WIRE IN LOOP
TYP. HORIZONTAL FENCE WIRE
END POST OR GATE FRAME
NOTE: SIMILAR DETAIL FOR VERTICAL WIRES ON GATE FRAME
TYPICAL FENCE TERMINATION
NOT TO SCALE
NOTES:
1. FOR ROCK ANCHOR, REFERENCE SS 206
2. MINIMUM GAP MUST BE LESS THAN 150 mm
3. REPAIR OF DAMAGED ZINC COATING SHALL BE IN ACCORDANCE WITH SS 422.40.
BRITISH COLUMBIA
Ministry of Transportation
No.
Revision
Date
WILDLIFE EXCLUSION FENCING
CONNECTION TREATMENT AT STRUCTURES
Issue Date JULY 2008
SPECIFICATION DRAWING No.
SP700-11



PLAN VIEW
SINGLE ONE WAY UNGULATE GATE LAYOUT
NOT TO SCALE

NOTES:

1) NYLON, OR OTHER SUITABLE PLASTIC, BUSHINGS SHALL BE INSTALLED ON THE GATE HINGES, TO LAY AGAINST THE MOUNTING PLATE.

2) 38mm X 50mm PATCHES OF 3mm NEOPRENE RUBBER SHALL BE PERMANENTLY ATTACHED TO EACH SWINGING SECTION, USING A SILICON ADHESIVE, SO THAT THE GATE CAN BE SLAMMED SHUT WITHOUT NOISE.

3) ALL METAL IN THE GATE ASSEMBLY SHALL BE GALVANIZED.

4) THE GATE TINES ONLY SHALL BE HEAT TREATED TO ROCKWELL HRC 30 TO 35.

5) ACID BATH TREATMENT OF THE TINES PRIOR TO GALVANIZING SHALL BE CONTROLLED TO MINIMIZE POTENTIAL WEAKENING OF WELDS.

6) GATES SHALL BE CAREFULLY FABRICATED AND WELDED TO AVOID BINDING. COMPLETED GATES SHALL BE TEST ASSEMBLED IN SHOP, ADJUSTED AND LUBRICATED TO SWING FREELY AND QUIETLY SHUT FROM ANY POSITION.

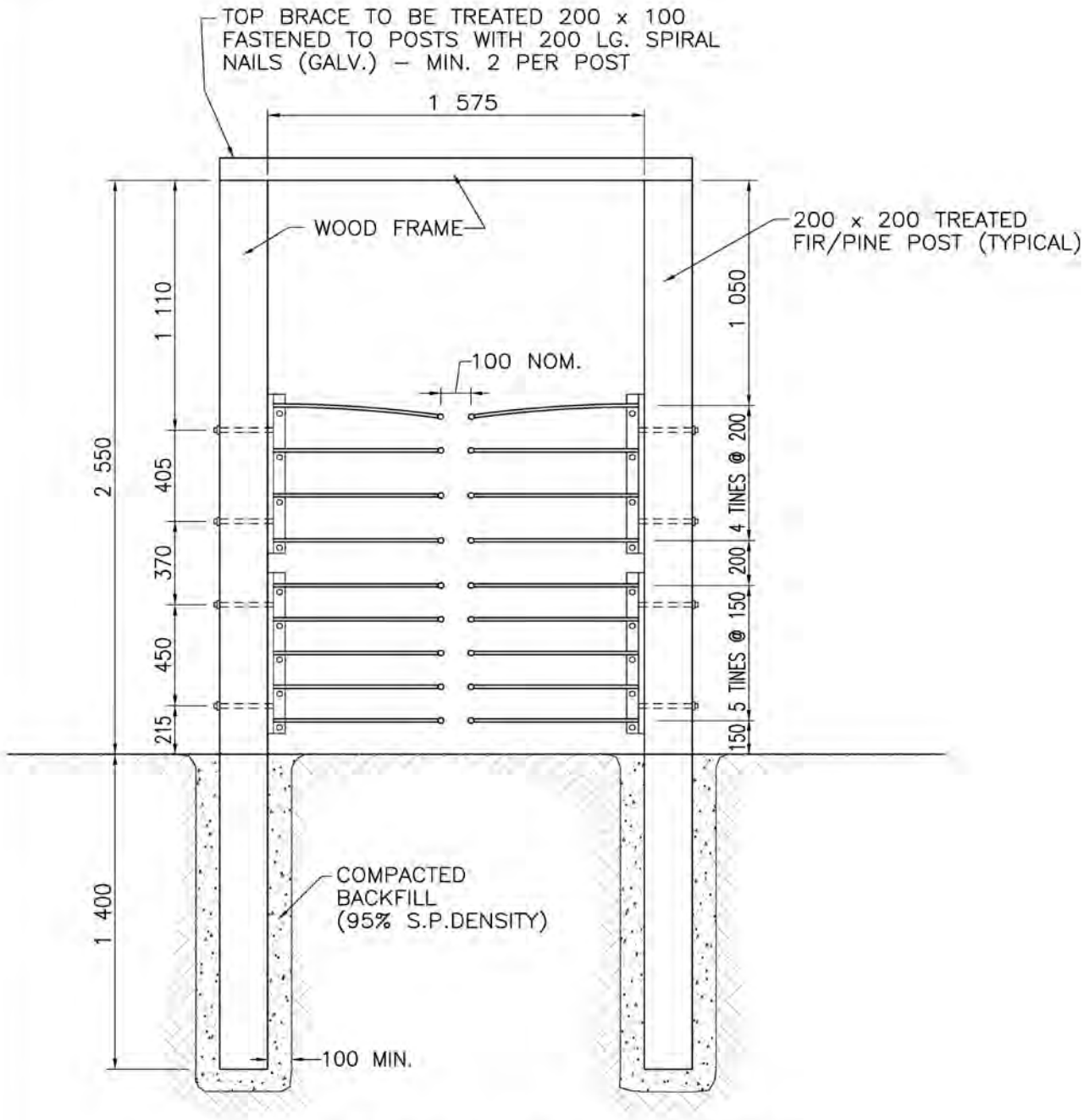
7) ALL STEELWORK TO BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH SS422. GALVANIZING TO BE IN ACCORDANCE WITH C.S.A. SPECIFICATION G164, TABLE 1.

8) DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SP700–12.2 TO 12.7

9) BACKFILL TO BE a) IN FREE DRAINING NON–COHESIVE SOILS – NATIVE MATERIALS
b) IN COHESIVE SOILS – MIX NATIVE MATERIAL 1 TO 1 WITH COARSE ROCK AGGREGATE (MAX 75mm ø)

10) FABRICATION TO BE IN ACCORDANCE WITH STANDARD SPECIFICATION SECTION 422 MISCELLANEOUS STEELWORK.

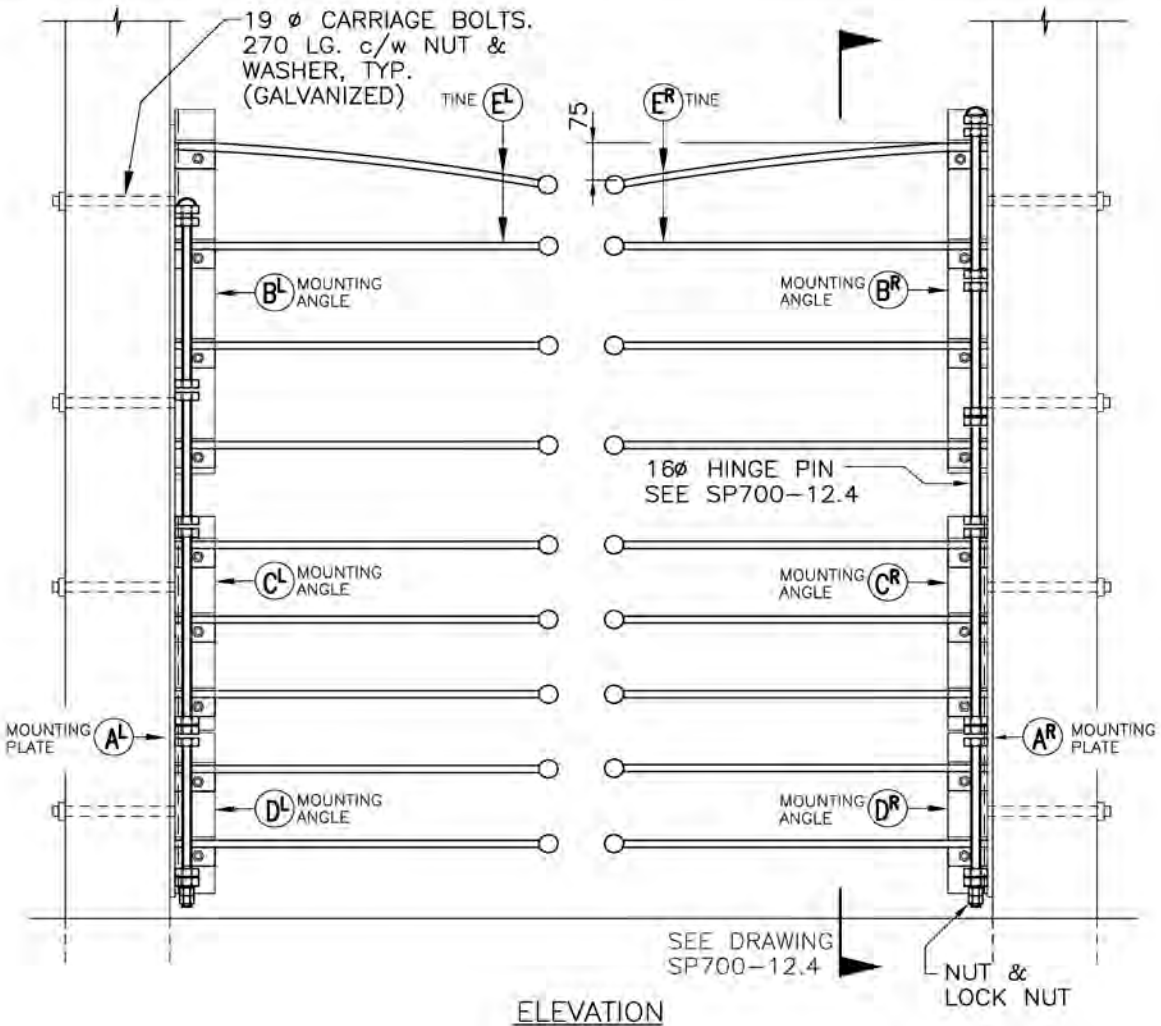
BRITISH COLUMBIA / Ministry of Transportation	ONE WAY UNGULATE GATE UNGULATE GATE SHOP DRAWING ASSEMBLY LAYOUT	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–12.1



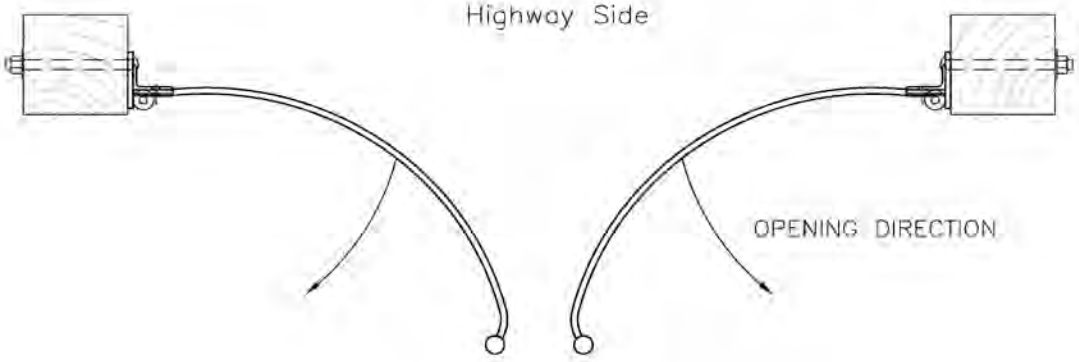
ONE WAY UNGULATE GATE ASSEMBLY

NOT TO SCALE

BRITISH COLUMBIA / Ministry of Transportation	ONE WAY UNGULATE GATE UNGULATE GATE SHOP DRAWING ASSEMBLY LAYOUT	
No. / Revision / Date		SPECIFICATION DRAWING No. SP700–12.2
	Issue Date JULY 2008	



ELEVATION

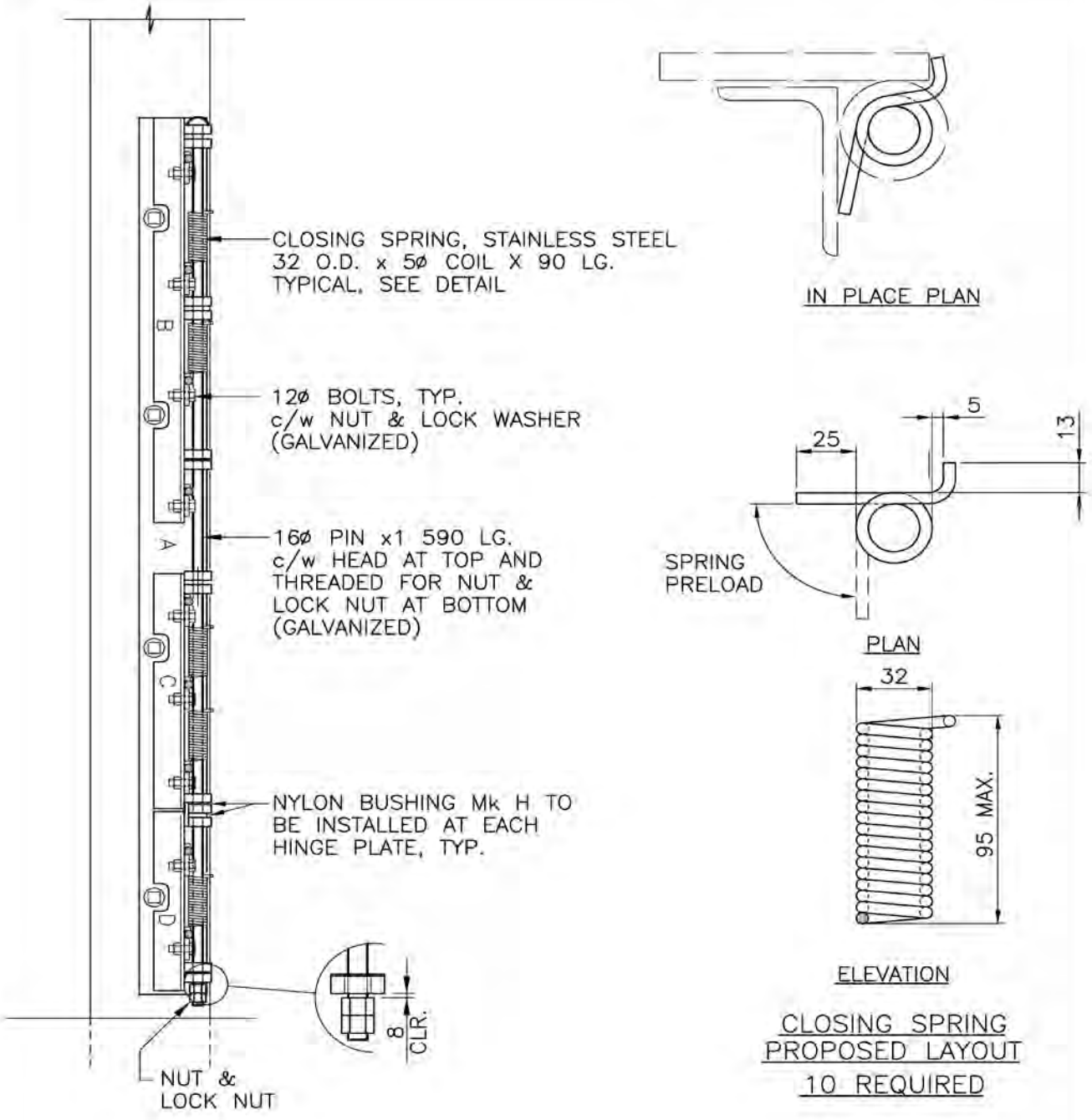


PLAN

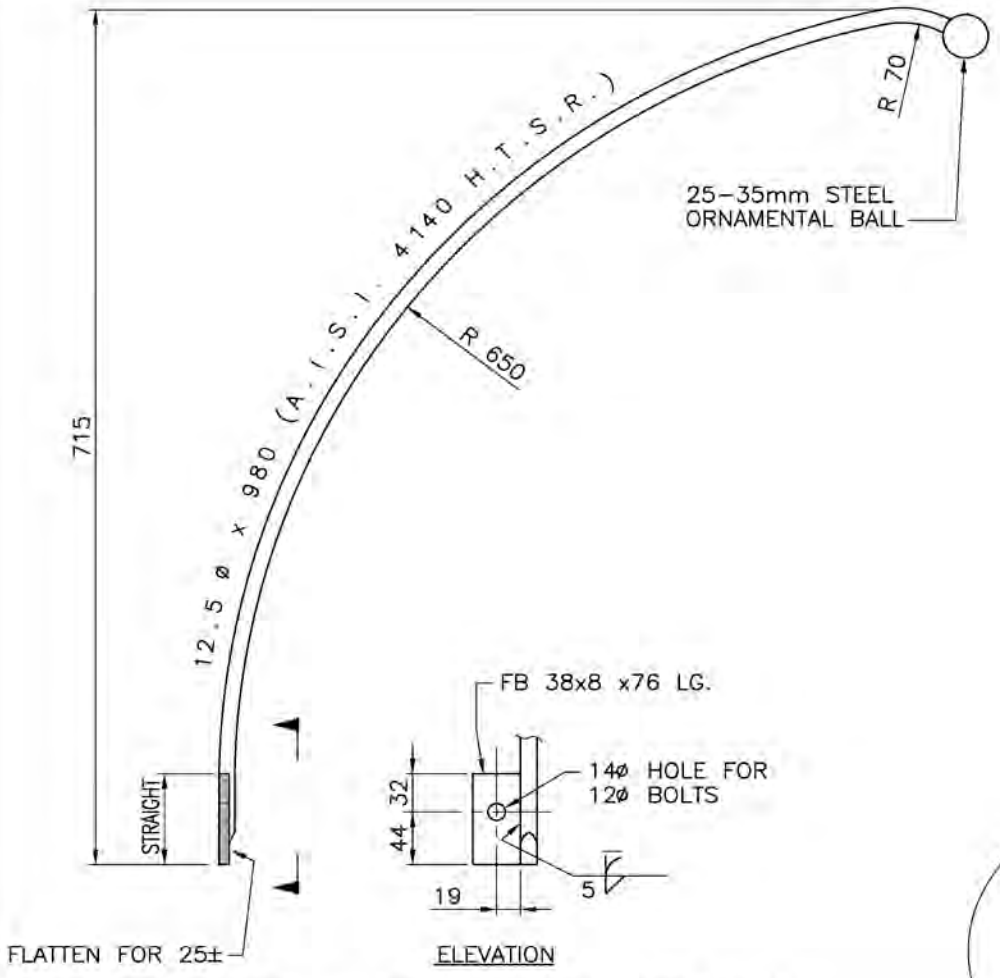
GENERAL ARRANGEMENT

NOT TO SCALE

BRITISH COLUMBIA / Ministry of Transportation	ONE WAY UNGULATE GATE GENERAL GATE ASSEMBLY	
No. / Revision / Date	Issue Date JULY 2008	SPECIFICATION DRAWING No. SP700-12.3

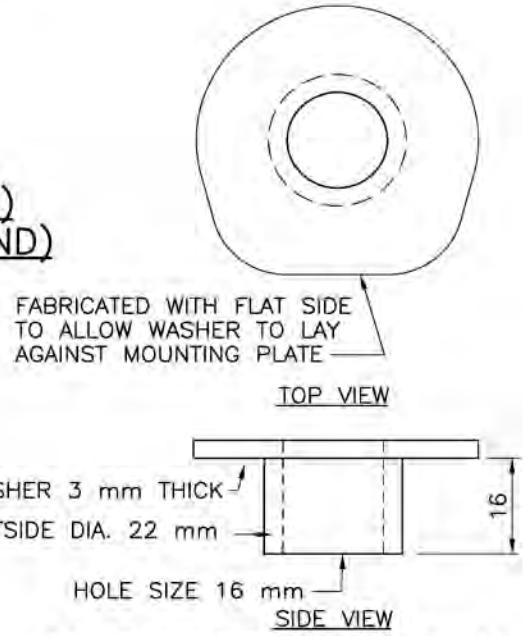


BRITISH COLUMBIA / Ministry of Transportation		ONE WAY UNGULATE GATE GATE ASSEMBLY – SIDE VIEW	
No.	Revision / Date		SPECIFICATION DRAWING No.
		Issue Date JULY 2008	SP700–12.4



9 REQUIRED – TINE Mk E^R (SHOWN)
9 REQUIRED – TINE Mk E^L (OPP. HAND)

NOT TO SCALE

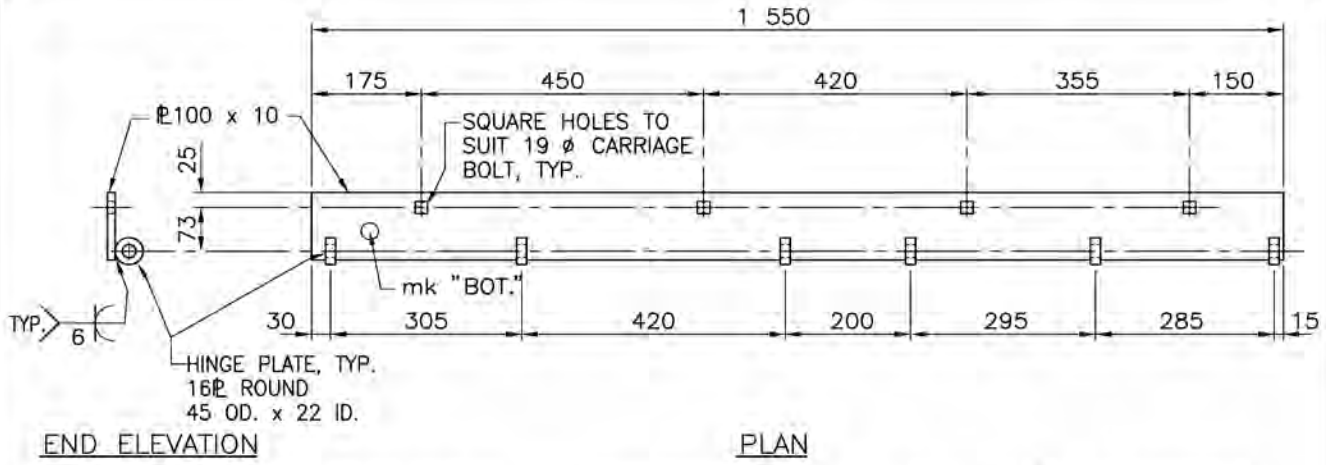


NYLON BUSHINGS Mk H

NOT TO SCALE

22 REQUIRED

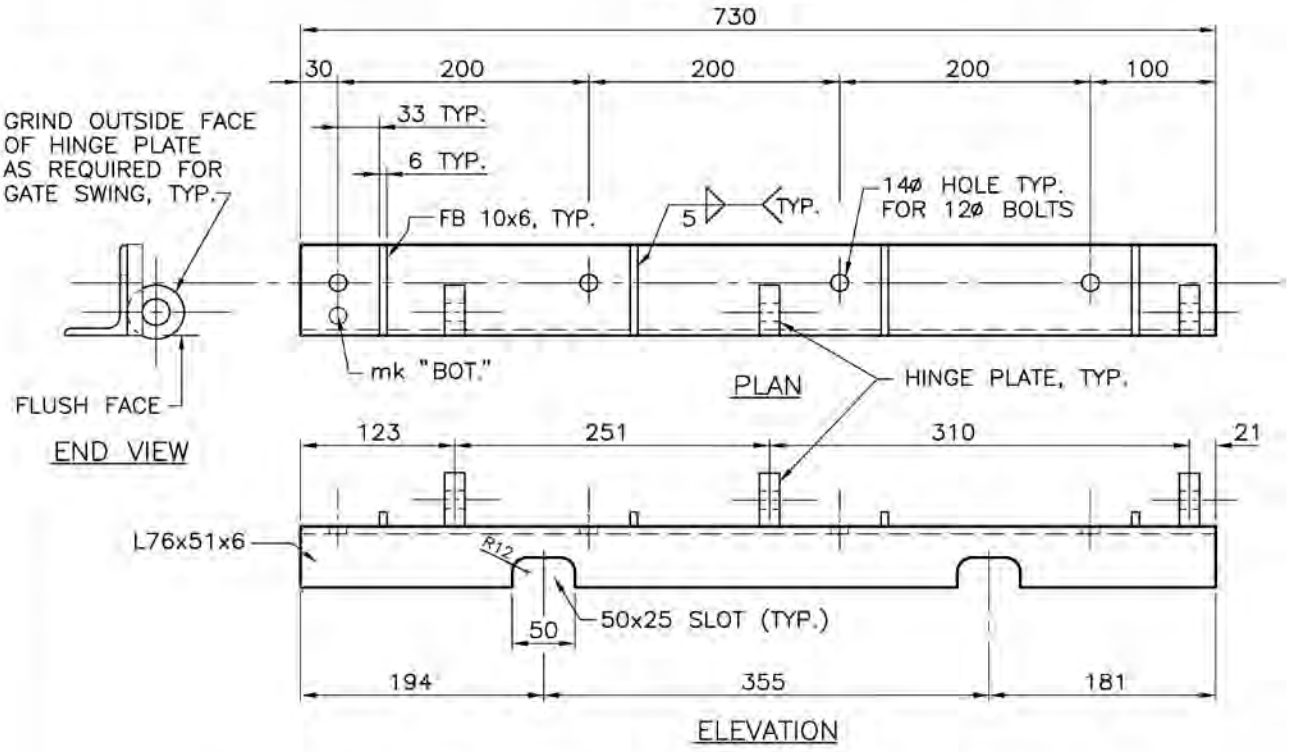
BRITISH COLUMBIA / Ministry of Transportation	ONE WAY UNGULATE GATE TINE & BUSHING	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–12.5



END ELEVATION PLAN

ONE REQUIRED – MOUNTING PL – Mk. A1^{R} (SHOWN)
ONE REQUIRED – MOUNTING PL – Mk. A1^{L} (OPP. HAND)

NOT TO SCALE

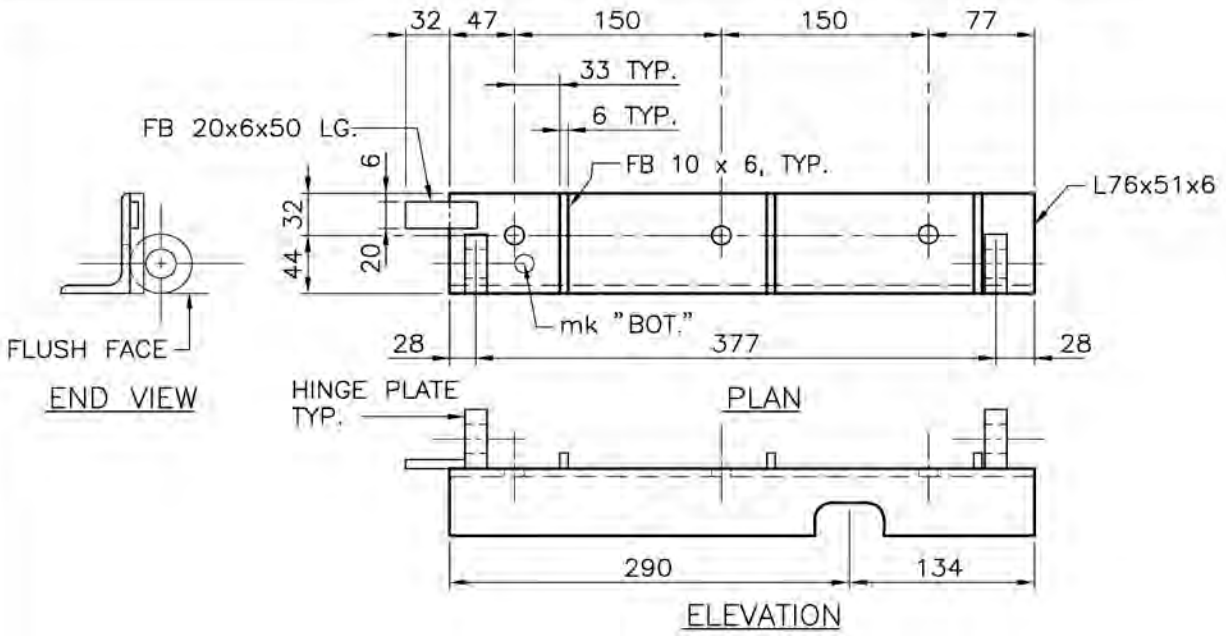


ELEVATION

ONE REQUIRED – ANGLE Mk B^{R} (SHOWN)
ONE REQUIRED – ANGLE Mk B^{L} (OPP. HAND)

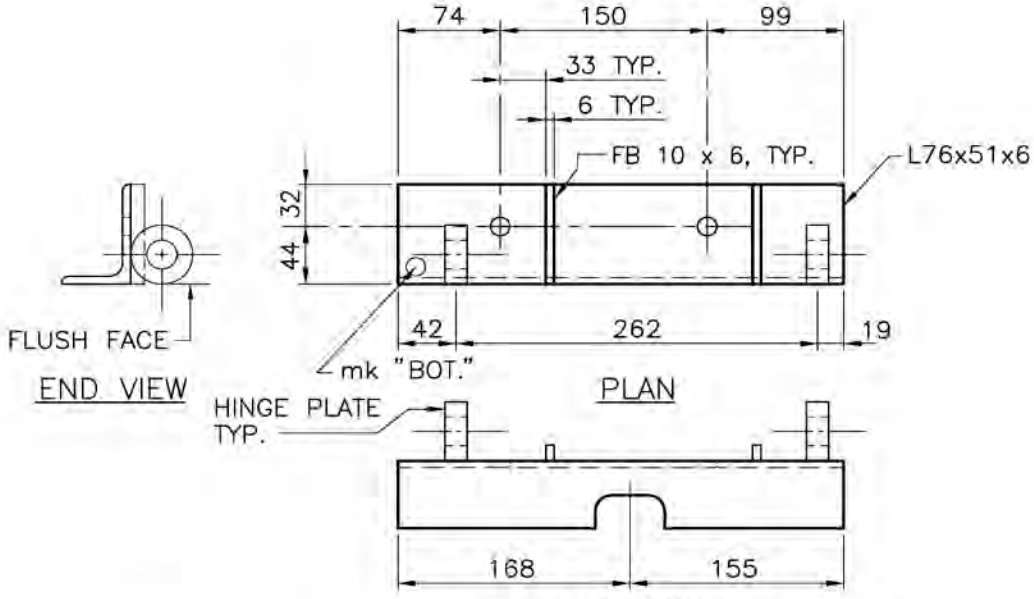
NOT TO SCALE

BRITISH COLUMBIA / Ministry of Transportation	ONE WAY UNGULATE GATE MOUNTING BRACKETS Mk. A & B	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–12.6



ONE REQUIRED – ANGLE Mk. C^R (SHOWN)
ONE REQUIRED – ANGLE Mk. C^L (OPP. HAND)

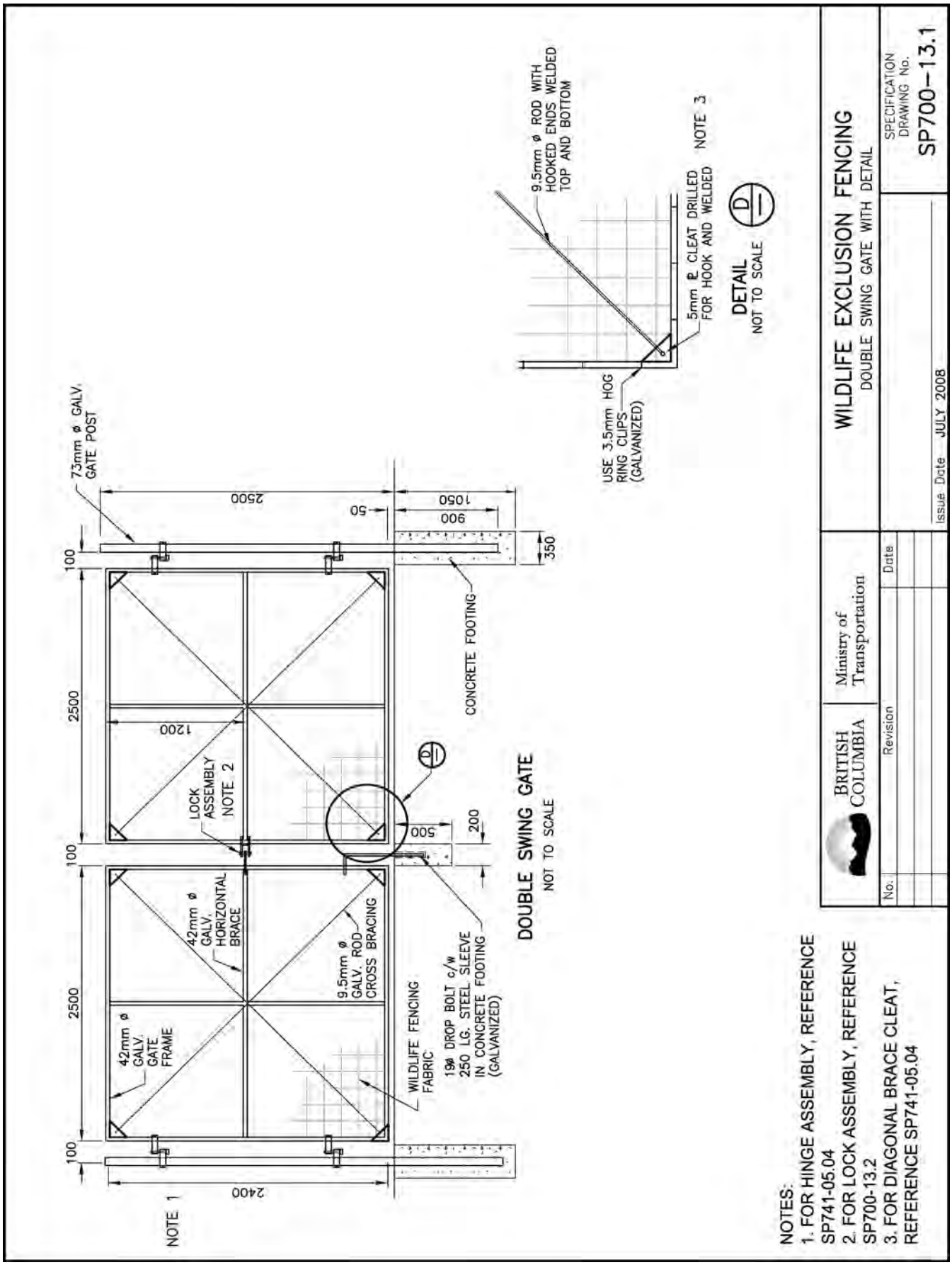
NOT TO SCALE

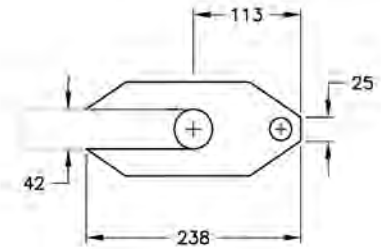


ONE REQUIRED – ANGLE Mk D^R (SHOWN)
ONE REQUIRED – ANGLE Mk D^L (OPP. HAND.)

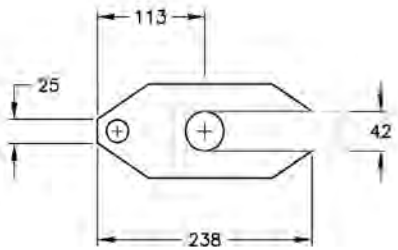
NOT TO SCALE

BRITISH COLUMBIA / Ministry of Transportation	ONE WAY UNGULATE GATE MOUNTING BRACKETS Mk. C & D	
No. / Revision / Date		SPECIFICATION DRAWING No.
	Issue Date JULY 2008	SP700–12.7

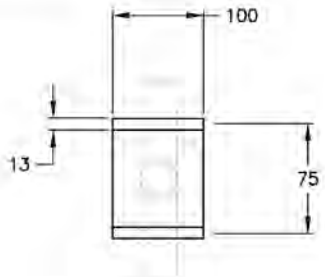

WILDLIFE EXCLUSION FENCING
DOUBLE SWING GATE WITH DETAIL
BRITISH COLUMBIA
Ministry of Transportation
No. Revision Date
Issue Date JULY 2008
SPECIFICATION DRAWING No.
SP700-13.1
DOUBLE SWING GATE
NOT TO SCALE
DETAIL
NOT TO SCALE
NOTE 1
NOTE 3
73mm ø GALV. GATE POST
42mm ø GALV. GATE FRAME
42mm ø GALV. HORIZONTAL BRACE
9.5mm ø GALV. ROD CROSS BRACING
LOCK ASSEMBLY NOTE 2
WILDLIFE FENCING FABRIC
19ø DROP BOLT c/w 250 LG. STEEL SLEEVE IN CONCRETE FOOTING (GALVANIZED)
CONCRETE FOOTING
9.5mm ø ROD WITH HOOKED ENDS WELDED TOP AND BOTTOM
5mm ø CLEAT DRILLED FOR HOOK AND WELDED
USE 3.5mm HOG RING CLIPS (GALVANIZED)
2400
2500
1200
500
200
1050
900
50
350
100
NOTES:
1. FOR HINGE ASSEMBLY, REFERENCE SP741-05.04
2. FOR LOCK ASSEMBLY, REFERENCE SP700-13.2
3. FOR DIAGONAL BRACE CLEAT, REFERENCE SP741-05.04



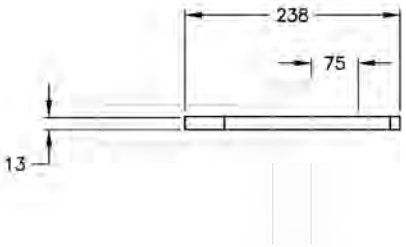
TOP VIEW



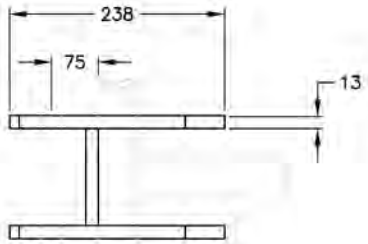
TOP VIEW



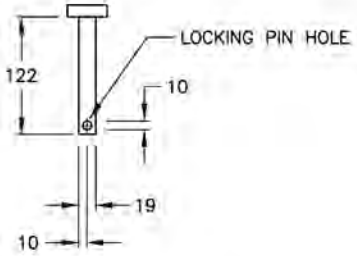
FRONT VIEW



SIDE VIEW



SIDE VIEW



PIN DIMENSION

LOCK ASSEMBLY DETAIL – LEFT GATE
NOT TO SCALE

LOCK ASSEMBLY DETAIL – RIGHT GATE
NOT TO SCALE

LOCK MECHANISM DETAIL

NOTES:
1. FOR DOUBLE SWING GATE, REFERENCE SP700-13.1

BRITISH COLUMBIA | Ministry of Transportation

No.	Revision	Date

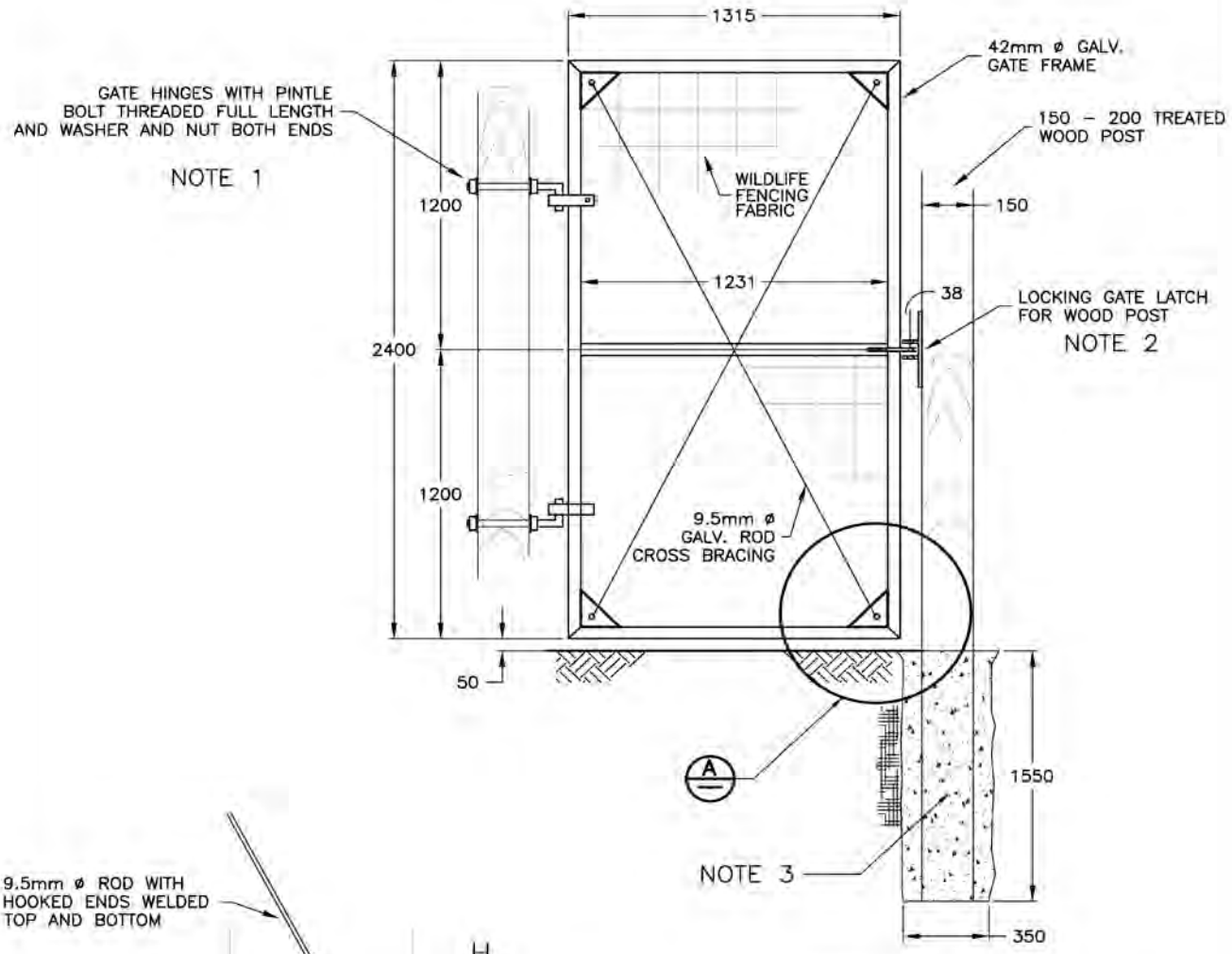
WILDLIFE EXCLUSION FENCING
DOUBLE SWING GATE LOCK MECHANISM DETAILS

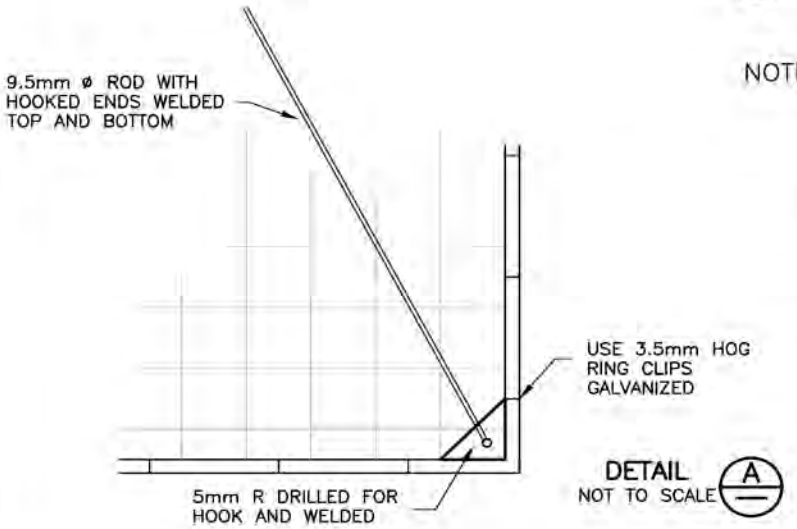
Issue Date JULY 2008

SPECIFICATION DRAWING No.
SP700–13.2

LOCKABLE HUMAN ACCESS GATE

NOT TO SCALE





DETAIL A
NOT TO SCALE

NOTES:
1. GATE HINGE, REFERENCE SP741-04.04
2. GATE LATCH FOR WOOD POST, REFERENCE SP700-14.2
3. WELL TAMPED BACKFILLS
   (A) IN FREE DRAINING, NON-COHESIVE SOILS, USE NATIVE MATERIALS
   (B) IN COHESIVE SOILS, MIX NATIVE MATERIAL 50-50 WITH COARSE ROCK AGGREGATE (MAX. 75mm Ø)

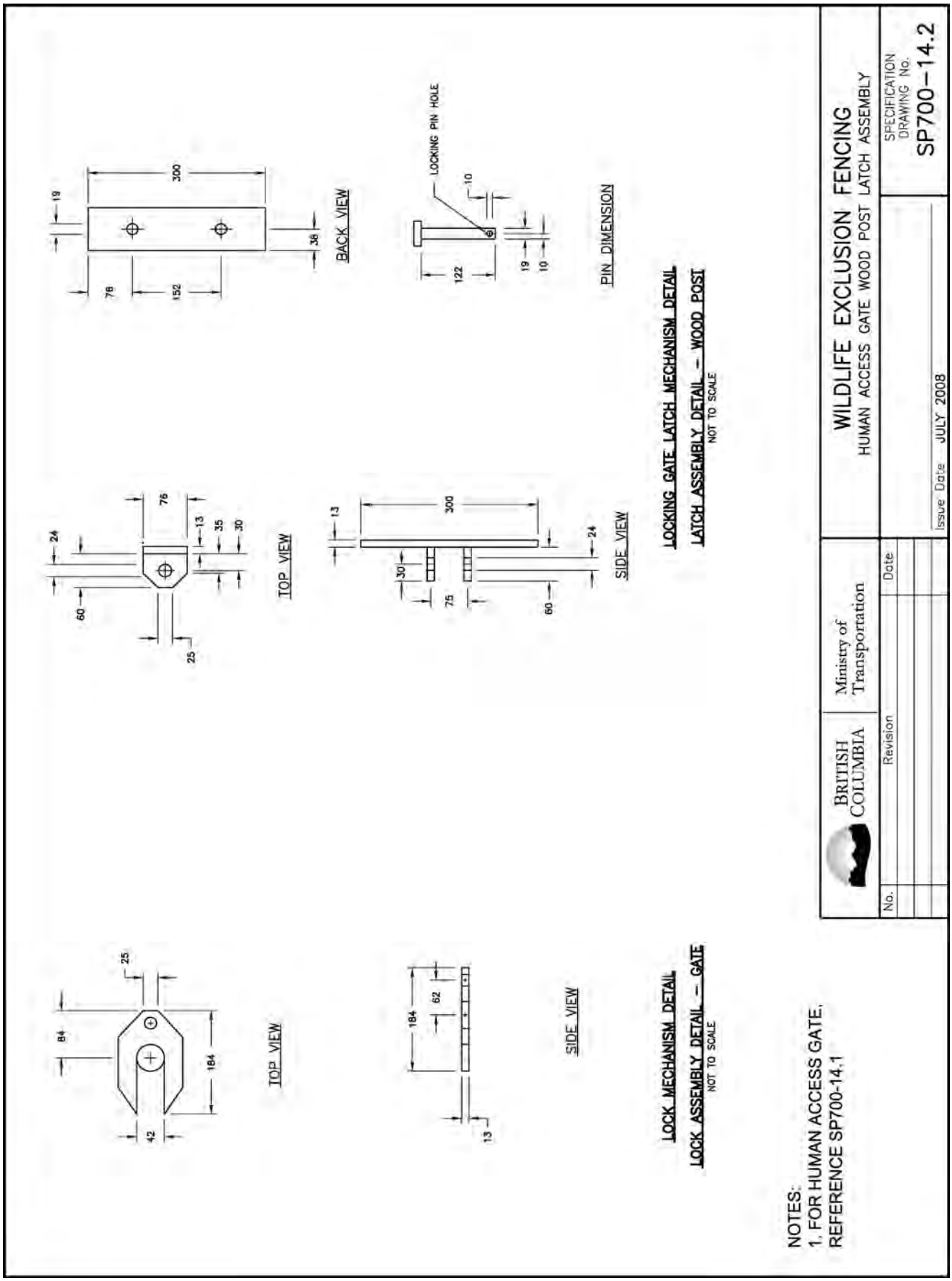
BRITISH COLUMBIA | Ministry of Transportation

WILDLIFE EXCLUSION FENCING
LOCKABLE HUMAN ACCESS GATE AND DETAIL

No.	Revision	Date

Issue Date JULY 2008

SPECIFICATION DRAWING No.
SP700–14.1


BRITISH COLUMBIA
Ministry of Transportation
WILDLIFE EXCLUSION FENCING
HUMAN ACCESS GATE WOOD POST LATCH ASSEMBLY
SPECIFICATION DRAWING No.
SP700-14.2
No. Revision Date
Issue Date JULY 2008
LOCKING GATE LATCH MECHANISM DETAIL
LATCH ASSEMBLY DETAIL - WOOD POST
NOT TO SCALE
BACK VIEW
TOP VIEW
SIDE VIEW
PIN DIMENSION
LOCKING PIN HOLE
LOCK MECHANISM DETAIL
LOCK ASSEMBLY DETAIL - GATE
NOT TO SCALE
TOP VIEW
SIDE VIEW
NOTES:
1. FOR HUMAN ACCESS GATE, REFERENCE SP700-14.1

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Zps-013 & Zps-064 Series

H0 3270-2 Wildlife Jumpout-Structure Hazard

BRITISH COLUMBIA

The Best Place on Earth

Ministry of Transportation and Infrastructure

Approved
August 10, 2010
5 Pages (including Cover)

BRITISH COLUMBIA
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Ministry of Transportation and Infrastructure

Z-RECORD

Highway Engineering Special Purpose Signs

Regional Traffic Engineer Approval Required for all NEW Placements (unless otherwise stated)

Sign Series

Zps-064

Zps-013

For use as a parent sign with Zps-013 acting as a tab.

Ref: H0-3270-1

Approved: August 10, 2010
Jerry Froese
Senior Traffic Engineer

Sign Item Number	Dimensions (W x H) mm	Substrate	Reflectivity ASTM Type	Colour	Approval Required	Typical Application
Zps-064	300 x 300	0.081 AL	9	B / FLY	STE	Pedestrian
	Sign Description: Pedestrian Fall Hazard symbol Danger Fall Hazard text					
-	-	-	-	-	-	-
	Sign Description: -					
-	-	-	-	-	-	-
	Sign Description: -					
-	-	-	-	-	-	-
	Sign Description: -					

BRITISH COLUMBIA
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Ministry of Transportation and Infrastructure

Z-RECORD

Highway Engineering Special Purpose Signs

Regional Traffic Engineer Approval Required for all NEW Placements (unless otherwise stated)

Sign Series

Zps-013

Ref: H0-3270-1

Approved: August 10, 2010
Jerry Froese
Senior Traffic Engineer

Sign Item Number	Dimensions (W x H) mm	Substrate	Reflectivity ASTM Type	Colour	Approval Required	Typical Application
Zps-013	300 x 300	0.081 AL	9	B, R / W	STE	Pedestrian
	Sign Description: Do Not Enter symbol & text					
-	-	-	-	-	-	-
	Sign Description: -					
-	-	-	-	-	-	-
	Sign Description: -					
-	-	-	-	-	-	-
	Sign Description: -					

From: Sielecki, Leonard E TRAN:EX
Sent: Thursday, January 7, 2010 1:06 PM
To: Sielecki, Leonard E TRAN:EX; 'C.F. Morley'; Tekano, Murray M TRAN:EX; Jensen, Jon C TRAN:EX; Grykuliak, Darcy T TRAN:EX; Buckingham, Angela TRAN:EX; 'Doug Kelly'; Fedoruk, Marni TRAN:EX; Izett, Alex TRAN:IN; 'Bill Harper'
Cc: Froese, Jerry F TRAN:EX
Subject: Environmental Team Meeting January 6 2010 Follow-up

Hello Jon:

Please find attached wildlife jumpout warning signs developed for the KCHP.

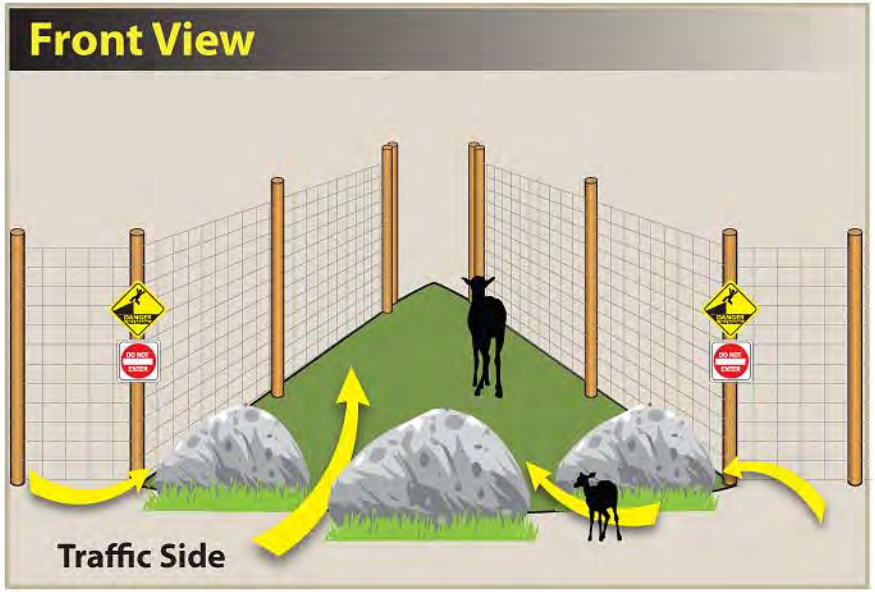
I had the sign designs approved by Jerry Froese, Senior Traffic Engineer, BC MoT HQ.

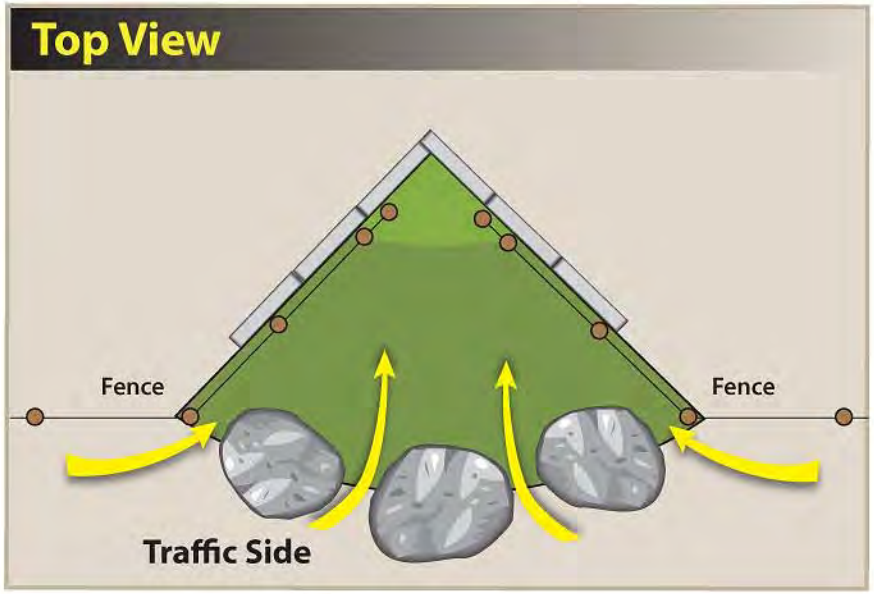
Jerry has recommended that the signs be made at 50% size of the smallest conventional warning signs so that they will be approx 30 cm x 30 cm. Jerry recommend this because the signs are for pedestrians and cyclists.

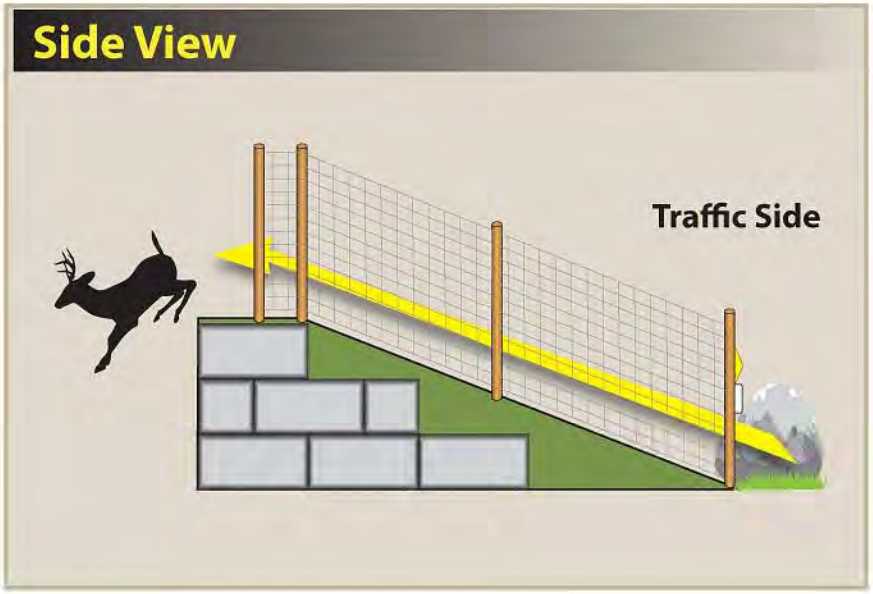
Jerry has also advised the signs should be positioned so that they do not reflect into the eyes of motorists driving on the highway and distract them.

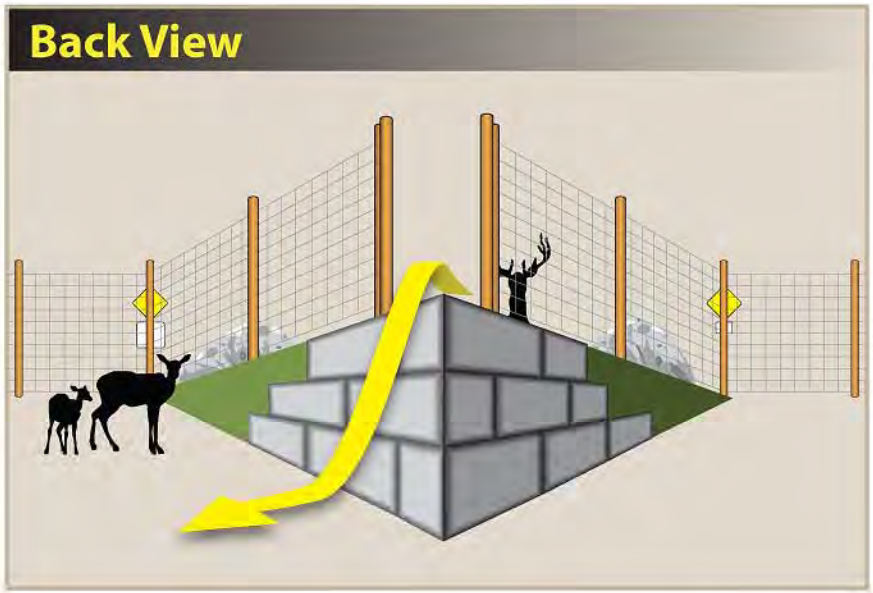
Len

Wildlife Jumpout









Conceptual design for discussion purposes only.

Leonard E. Sielecki, R.P.Bio, MCIP (BCMOT 2009)