APPENDIX D

GUIDELINES FOR UPGRADING BRIDGE APPROACH RAIL TRANSITIONS

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D
Guidelines For Upgrading Bridge Approach Rail Transitions

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D1

LIFE-CYCLE BENEFIT-COST ANALYSIS PROCEDURE FOR DETERMINING THE NEED FOR BRIDGE APPROACH RAIL TRANSITION UPGRADING

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D1

Life-Cycle Benefit-Cost Analysis Procedure for Determining the Need for Bridge Approach Rail Transition Upgrading

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

D1.1 INTRODUCTION

The analysis procedure for establishing the need to upgrade an existing bridge approach rail transition is based on the procedure in the 2003 INFTRA Report entitled *"Guidelines for Upgrading of Existing Bridgerails/Approach Rail Transitions in Alberta."* As discussed in Appendix C1, this analysis procedure is based on life-cycle benefit-cost analysis. A separate discussion of benefit-cost analysis is provided in Section H.3.3 of the Roadside Design Guide.

The Warrant AADT value required to justify upgrading an approach rail transition is defined as the AADT required for the present worth costs of upgrading (PWC1) to match the present worth costs of not upgrading (PWC2) based on a 2% traffic growth rate and achieving a 4% internal rate of return (IRR) over the project life. The project life is normally chosen to be 20 years, however a shorter time period should be chosen if it is expected that the bridge deck and/or bridgerail curb will be replaced sooner than 20 years.

PWC1 and PWC2 are defined as follows:

- PWC1 = present worth of upgrading costs and collision costs over 20 years or less corresponding to the upgraded bridge approach rail transition.
- PWC2 = present worth of collision costs over 20 years or less corresponding to the existing approach rail transition.

The need for upgrading the approach rail transitions for a particular bridge is determined by the following five step analysis procedure. Step 1 of this procedure begins on the following page.

Note that for the selected bridgerail types shown in Standard Drawings S-1711-07 to S-1720-07, the Warrant AADT may be determined from the Warrant Charts presented in Section HD1.2 of this appendix, rather than by using the following warrant procedure.

For undivided highways, the approach rail transitions will be upgraded the same at all four corners of a bridge, while for divided highways, only the approach rail transitions at the two upstream corners of the bridge require upgrading. In some situations, upgrading of the exit rail transitions at the downstream end of the bridge may be required, as shown on Standard Drawings S-1715-07 and S-1719-07.

Step 1: Approach Rail Transition Upgrading Costs

Determine the total capital costs of upgrading the approach rail transitions at the corners of the bridge requiring upgrading. Divide this total cost by the number of approach rail transitions requiring upgrading to determine the average cost of upgrading one corner of the bridge. This cost must then be converted to year 2000 dollars since the collision costs used by INFTRA are based on year 2000 data (refer to Section H.3.3).

If the approach rail transitions are to be upgraded in accordance with the details shown in INFTRA Standard Drawings S-1711-07 to S-1720-07, then the cost to upgrade the approach rail transition at one corner of a bridge may be taken from Table HD1.1.

Table HD1.1 – Assumed Bridge Approach Rail Transition Upgrading Costs

Approach Rail Transition Upgrading Standard Drawings	Upgrading Costs (per corner of bridge)			
	Year 2000 dollars[1]		Year 2007 dollars	
	Divided Highway	Undivided Highway	Divided Highway	Undivided Highway
Vertical Bar / Horizontal Rail Type Bridgerail on Safety Curb (Standard Drawings S-1711-07 to S-1715-07)	$ 10,700	$ 16,400	$ 16,100	$ 24,600
850 mm Double Tube Type Bridgerail on Safety Curb (Standard Drawings S-1716-07 to S-1719-07)	$ 8,600	$ 11,100	$ 12,900	$ 16,700
Single Layer Deep Beam (W-Beam) Bridgerail on Participating Curb (Type 1) – Bridgerail Mounted on 127 mm dia. Std Pipe Posts – Existing Approach Rail Typically not Connected to Bridgerail (Standard Drawing S-1720-07) [2]	$ 4,500	$ 5,500	$ 6,800	$ 8,300
Double Layer Deep Beam (W-Beam) Bridgerail on Participating Curb (Type 2) – Bridgerail Mounted on HSS127x127x6.35 Posts – Existing Approach Rail Typically Continuous with Bridgerail (Standard Drawing S-1720-07) [2]	$ 4,400	$ 5,300	$ 6,600	$ 8,000
Single/Double Layer Deep Beam (W-Beam) Bridgerail on Safety Curb – Bridgerail Mounted on 127 mm dia. Std Pipe Posts – Existing Approach Rail Typically not Connected to Bridgerail (Standard Drawing S-1720-07) [2]	$ 4,600	$ 5,600	$ 6,900	$ 8,400

[1] Upgrading costs in year 2000 dollars are used in the warrant analysis procedure to be consistent with the collision costs in Table HC1.7 (Appendix C1) which are also in year 2000 dollars.

[2] Includes cost of upgrading bridgerail.

Step 2: Severity Index (SI) and Corresponding Length (L)

Determine the Severity Index (SI) and corresponding length (L) of the existing approach rail transition. The corresponding length (L) is defined as the length of the approach rail transition that protects the end of the bridgerail and has the assigned severity index. The value "L" should not be confused with the physical length of the overall approach rail transition. Severity Indices and corresponding lengths are provided in Figures HD2.1 to HD2.4 (Appendix D2) for existing approach rail transitions used with different types of bridgerails.

Next, determine the Severity Index (SI) of the proposed upgraded approach rail transition. The SI value for the proposed upgraded approach rail transition must be determined based on the anticipated level of safety that the proposed upgraded transition will provide. To provide uniformity in upgrading bridge approach rail transitions across the province, standard approach rail transition upgrading drawings have been developed for the most common types of existing bridgerails currently on Alberta's roadways. These drawings are shown in Appendix D3. A summary of SI values are summarized in Table HD1.2:

Table HD1.2 – Standard Approach Rail Transition Upgrading Details and SI Values

Approach Rail Transition Upgrading Standard Drawings	SI Value of Upgraded Approach Rail Transition				
	Design Speed (km/h)				
	60	80	100	110	120
Vertical Bar / Horizontal Rail Type Bridgerail on Safety Curb (Standard Drawings S-1711-07 to S-1715-07)	2.1	2.5	3.1	3.4	3.8
850 mm Double Tube Type Bridgerail on Safety Curb (Standard Drawings S-1716-07 to S-1719-07)	2.1	2.5	3.1	3.4	3.8
Single Layer Deep Beam (W-Beam) Bridgerail on Participating Curb (Type 1) – Bridgerail Mounted on 127 mm dia. Std Pipe Posts – Existing Approach Rail Typically not Connected to Bridgerail (Standard Drawing S-1720-07)	2.1	2.6	3.3	3.6	4.0
Double Layer Deep Beam (W-Beam) Bridgerail on Participating Curb (Type 2) – Bridgerail Mounted on HSS127x127x6.35 Posts – Existing Approach Rail Typically Continuous with Bridgerail (Standard Drawing S-1720-07)	2.1	2.6	3.3	3.6	4.0
Single/Double Layer Deep Beam (W-Beam) Bridgerail on Safety Curb – Bridgerail Mounted on 127 mm dia. Std Pipe Posts – Existing Approach Rail Typically not Connected to Bridgerail (Standard Drawing S-1720-07)	2.1	2.6	3.3	3.6	4.0

For the few existing bridgerail types not listed in Table HD1.2, the upgrading concepts presented in the INFTRA Report entitled *"Guidelines for Upgrading of Existing Bridgerails/Approach Rail Transitions in Alberta"* should be reviewed for selecting an appropriate SI value for the upgraded approach rail transition.

Step 3: Determine Collision Frequency

Determine the collision frequency using the equation:

$F = 1.6 * R * k_c * k_g * P$

Where;

F = frequency of approach rail transition collisions (encroachments/km/year)

R = basic encroachment rate for assumed AADT (Appendix C1, Table HC1.1, see note below)

k_c = highway curvature factor (Appendix C1, Table HC1.2)

k_g = highway grade factor (Appendix C1, Table HC1.3)

P = lateral encroachment probability (Appendix C1, Table HC1.4)

Note: The basic encroachment rates shown in Table HC1.1 are multiplied by a factor of 1.6 in Step 3 to obtain the total encroachment rate for all lanes. This adjustment factor is equivalent to the Highway Multi-Lane Factor, k_m, discussed in Appendix C1. Refer to the note in Appendix C1, Section HC1.1, for clarification on the encroachment data presented in Table HC1.1.

Step 4: Present Worth Collision Costs

Determine the Present Worth Collision Costs (PWCC) using the following equation:

$PWCC = F * k_s * AC * L * KC / 1000$

Where;

F = frequency of approach rail transition collisions as defined in Step 3 (encroachments/km/year)

k_s = bridge height and occupancy factor (Appendix C1, Table HC1.6)

AC = cost per collision for severity index (Appendix C1, Table HC1.7)

L = length of the existing approach rail transition that protects the end of the bridgerail and which the assigned severity index of the existing approach rail transition is representative (refer to Figure HD2.1 to HD2.4)

KC = present worth conversion factor. Annual collision costs are converted to present worth at a discount rate of 4% and a traffic growth rate of 2%. If the project life is 20 years, KC is equal to 16.252. If the project life is less than 20 years due to the condition of the existing bridge, then a different present worth conversion factor value must be used in accordance with Table HC1.8 in Appendix C1.

Step 5: Determining "PWC1" and "PWC2"

"PWC1" is calculated by adding together the 1) present worth cost of upgrading the bridge approach rail transition (per corner of bridge) and 2) the present worth collision costs (per corner of bridge) determined in Step 4 for the upgraded approach rail transition.

"PWC2" is the present worth collision costs determined in Step 4 for the existing approach rail transition (per corner of bridge).

Conclusion: The alternative with the lowest present worth cost is the recommended alternative.

Step 6 (OPTIONAL): Iterating to Solve for the Warrant AADT

Steps 3 to 5 are repeated for different values of AADT until PWC1 equals PWC2. The AADT that yields PWC1 equal to PWC2 is the "Warrant AADT". Upgrading of the bridge approach rail transition is warranted when the traffic volume is equal to or greater than the Warrant AADT value.

D1.2 WARRANTS FOR UPGRADING EXISTING BRIDGE APPROACH RAIL TRANSITIONS

The Warrant Charts presented in this appendix shall be used for determining the need for upgrading the approach rail transitions for the following types of existing bridgerails:

Table HD1.3 – Warrant Charts for Upgrading Bridge Approach Rail Transitions

Bridgerail Type	Highway Type	Standard Drawing	**Warrant Chart**
Vertical Bar / Horizontal Rail	Undivided	S-1711-07 and S-1712-07	**Figures HD1.1A and HD1.1B**
Vertical Bar / Horizontal Rail	Divided	S-1713-07 to S-1715-07	**Figures HD1.2A and HD1.2B**
850 mm Double Tube	Undivided	S-1716-07 to S-1718-07	**Figures HD1.3A and HD1.3B**
850 mm Double Tube	Divided	S-1716-07 to S-1719-07	**Figures HD1.4A and HD1.4B**
Single Layer Deep Beam on Participating Curb (Type 1)[1]	Undivided	S-1720-07	**Figures HD1.5A and HD1.5B**
Single Layer Deep Beam on Participating Curb (Type 1)[1]	Divided	S-1720-07	**Figures HD1.6A and HD1.6B**
Double Layer Deep Beam on Participating Curb (Type 2)[2]	Undivided	S-1720-07	**Figures HD1.7A and HD1.7B**
Double Layer Deep Beam on Participating Curb (Type 2)[2]	Divided	S-1720-07	**Figures HD1.8A and HD1.8B**
Single or Double Layer Deep Beam on Safety Curb[1]	Undivided	S-1720-07	**Figures HD1.9A and HD1.9B**
Single or Double Layer Deep Beam on Safety Curb[1]	Divided	S-1720-07	**Figures HD1.10A and HD1.10B**

[1] Bridgerail Mounted on 127 mm dia. Std Pipe Posts – Existing Approach Rail Typically not Connected to Bridgerail.

[2] Bridgerail Mounted on HSS127x127x6.35 Posts – Existing Approach Rail Typically Continuous with Bridgerail.

These Warrant Charts have been created following the six step warranting procedure in Section HD1.1. They may be used for quickly establishing the Warrant AADT necessary to justify the upgrade of existing bridge approach rail transitions. The Warrant AADT is a function of the following variables:

- Highway Design Speed
- Highway Shoulder Width
- Highway Curvature, k_c (refer to Table HC1.2 in Appendix C1)
- Highway Grade, k_g (refer to Table HC1.3 in Appendix C1)
- Bridge Height and Occupancy, k_s (refer to Table HC1.6 in Appendix C1)

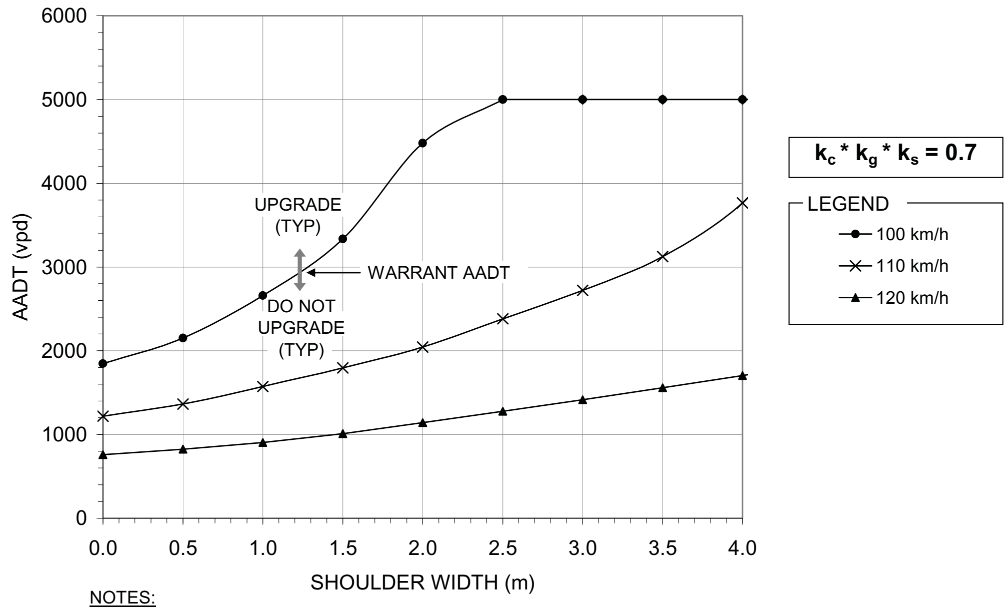
The approach rail transition warrant charts presented in Figures HD1.1A to HD1.10B are based on:

- the assumed capital costs for upgrading stated previously in Table HD1.1
- the SI values for the upgraded approach rail transitions summarized in Table HD1.2
- the SI and corresponding length values for the existing approach rail transitions shown in Figure HD2.1 to HD2.4 in Appendix D2
- a 20 year project life with a 4% discount rate and a 2% traffic growth rate.

The warrant charts are presented as two sets of curves per page to allow for linear interpolation. The set of curves in the top figure, labeled as Figure A, are based on holding the product of $k_c * k_g * k_s$ equal to 0.7; the set of curves in the bottom figure, labeled as Figure B, are based on holding the product of $k_c * k_g * k_s$ equal to 2.0. Intermediate values of $k_c * k_g * k_s$ can be calculated by linear interpolation between the two sets of curves. For values of $k_c * k_g * k_s$ exceeding 2.0, the six step detailed warrant procedure stated above should be followed.

The approach rail transition should be upgraded if the actual AADT is equal to or greater than the Warrant AADT value.

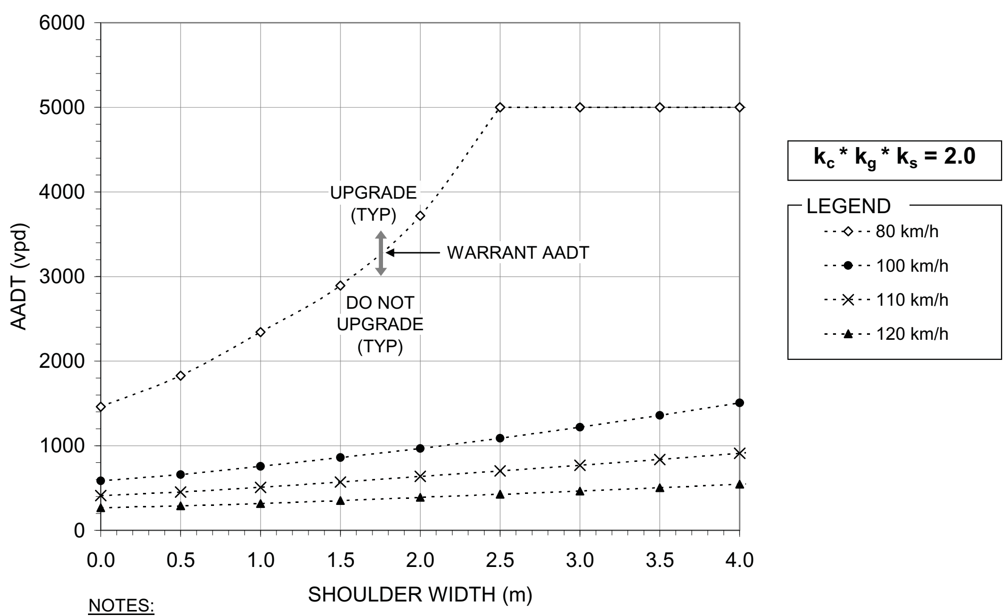
FIGURE HD1.1A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "VERTICAL BAR / HORIZONTAL RAIL" TYPE BRIDGERAIL - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1711-07 AND S-1712-07)



NOTES:

- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 100 km/h.
- ASSUME A WARRANT AADT OF 5000 vpd FOR THE DESIGN SPEED OF 80 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.1A AND HD1.1B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

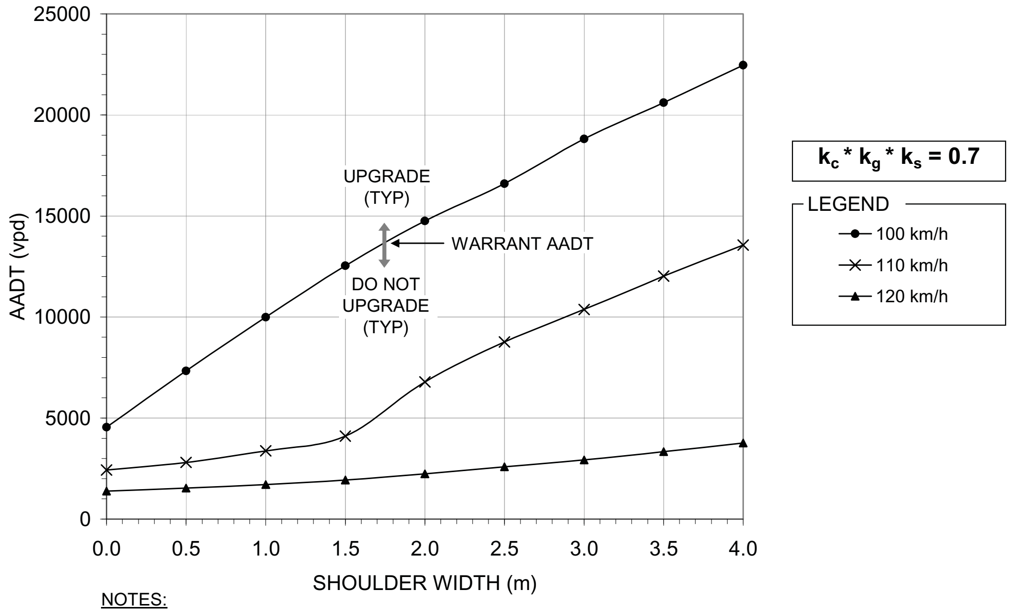
FIGURE HD1.1B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "VERTICAL BAR / HORIZONTAL RAIL" TYPE BRIDGERAIL - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1711-07 AND S-1712-07)



NOTES:

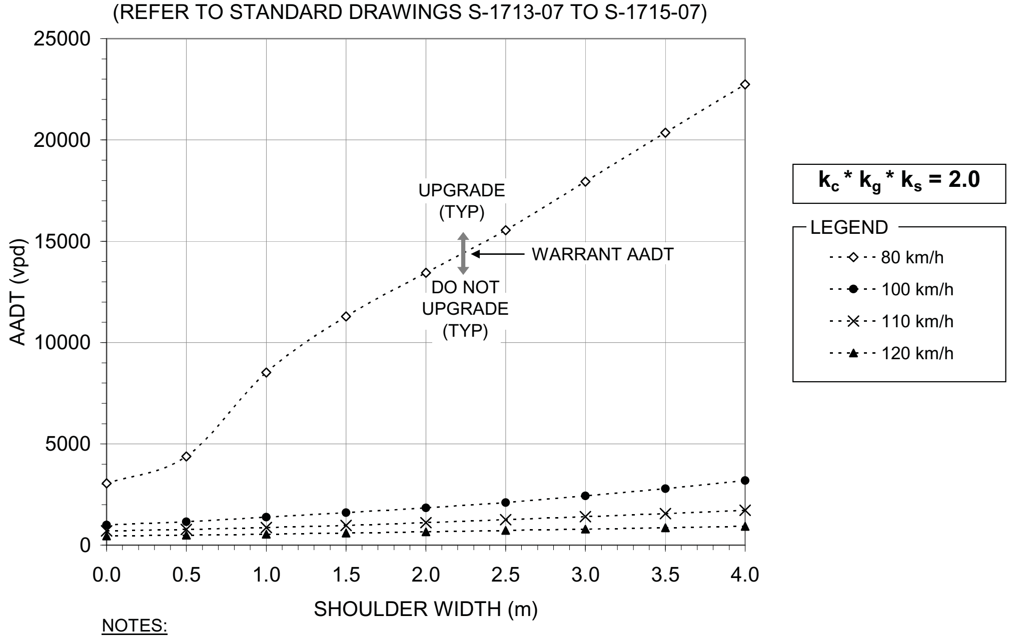
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.2A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "VERTICAL BAR / HORIZONTAL RAIL" TYPE BRIDGERAIL - DIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1713-07 TO S-1715-07)



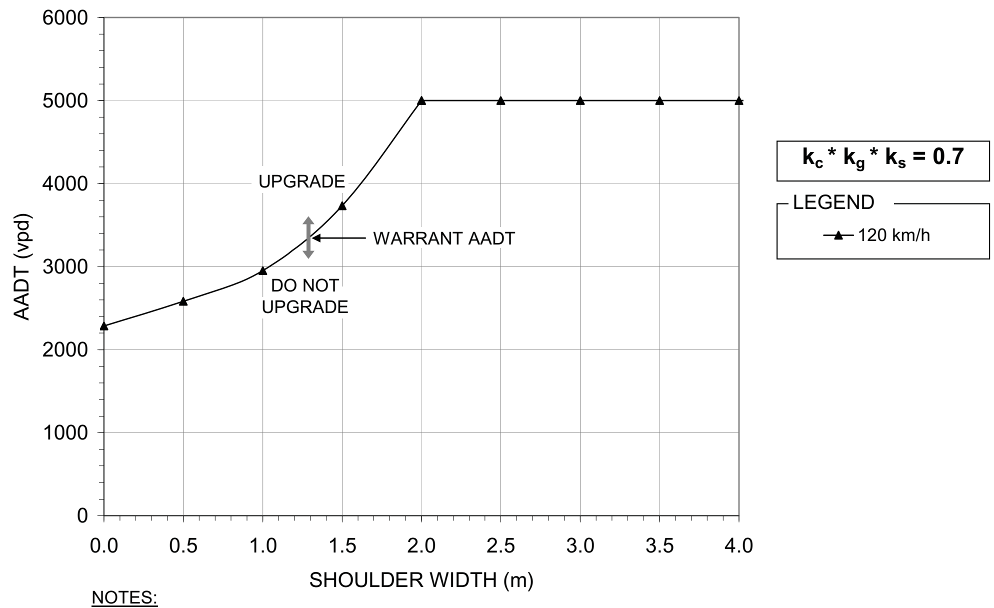
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 100 km/h.
- ASSUME A WARRANT AADT OF 25000 vpd FOR THE DESIGN SPEED OF 80 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.2A AND HD1.2B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.2B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "VERTICAL BAR / HORIZONTAL RAIL" TYPE BRIDGERAIL - DIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1713-07 TO S-1715-07)



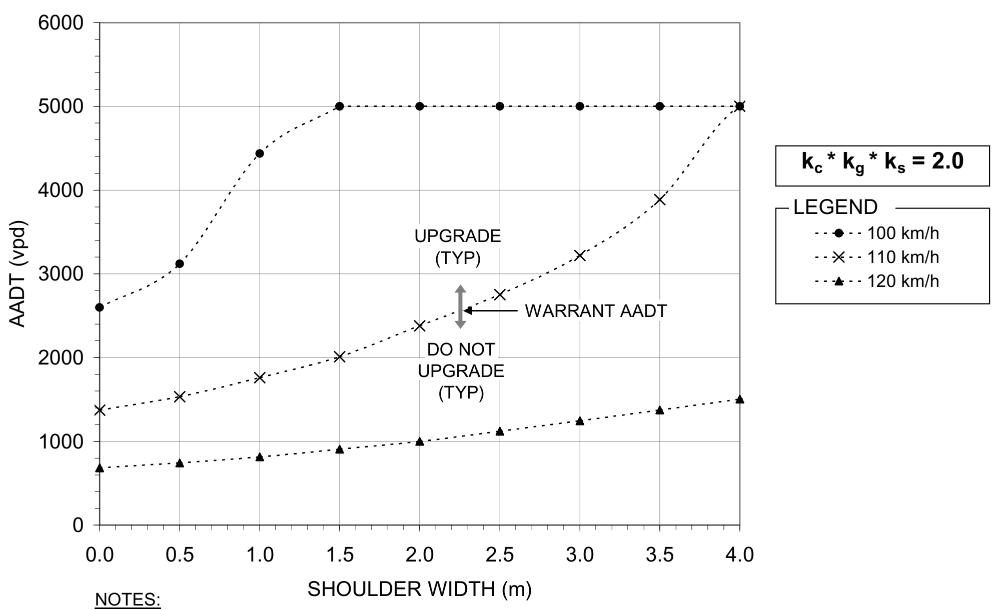
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.3A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "850 mm DOUBLE TUBE" TYPE BRIDGERAIL - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1716-07 TO S-1718-07)



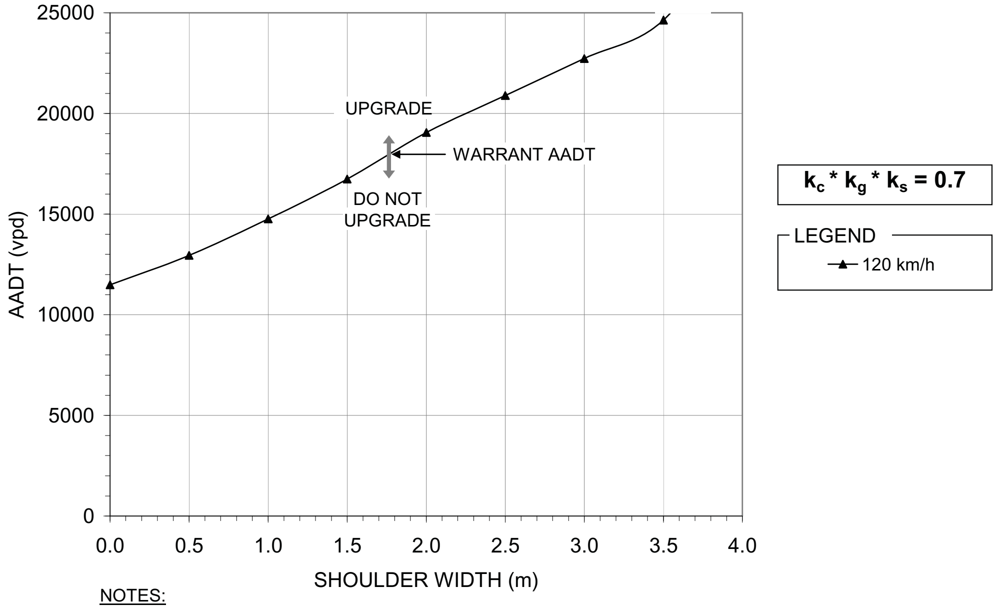
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 120 km/h.
- ASSUME A WARRANT AADT OF 5000 vpd FOR THE DESIGN SPEED OF 100 km/h AND 110 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.3A AND HD1.3B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.3B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "850 mm DOUBLE TUBE" TYPE BRIDGERAIL - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1716-07 TO S-1718-07)



NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 100 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

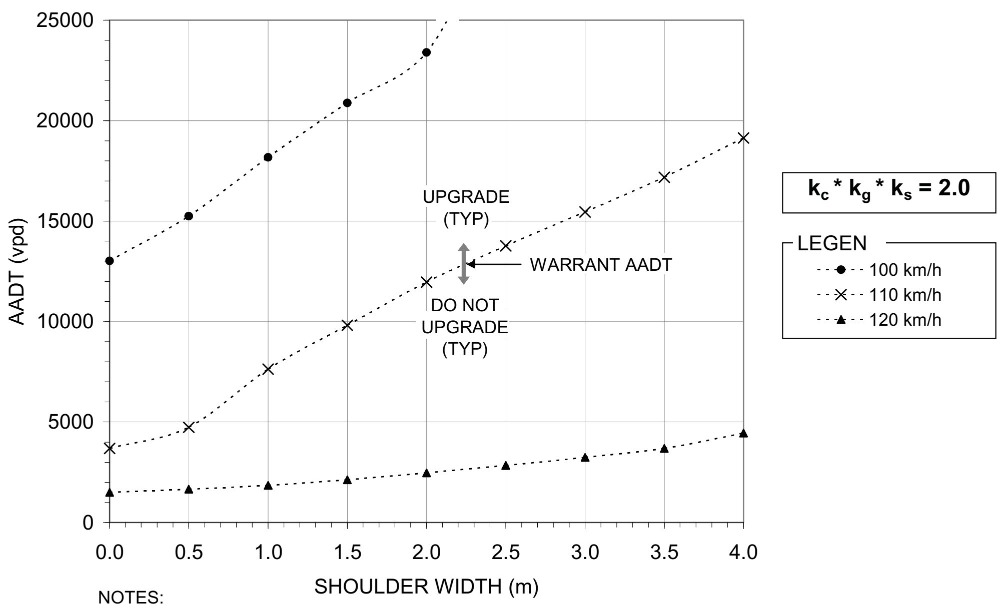
FIGURE HD1.4A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "850 mm DOUBLE TUBE" TYPE BRIDGERAIL - DIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1716-07 TO S-1719-07)



NOTES:

- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 120 km/h.
- ASSUME A WARRANT AADT OF 25000 vpd FOR DESIGN SPEEDS OF 100 km/h AND 110 kph FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.4A AND HD1.4B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

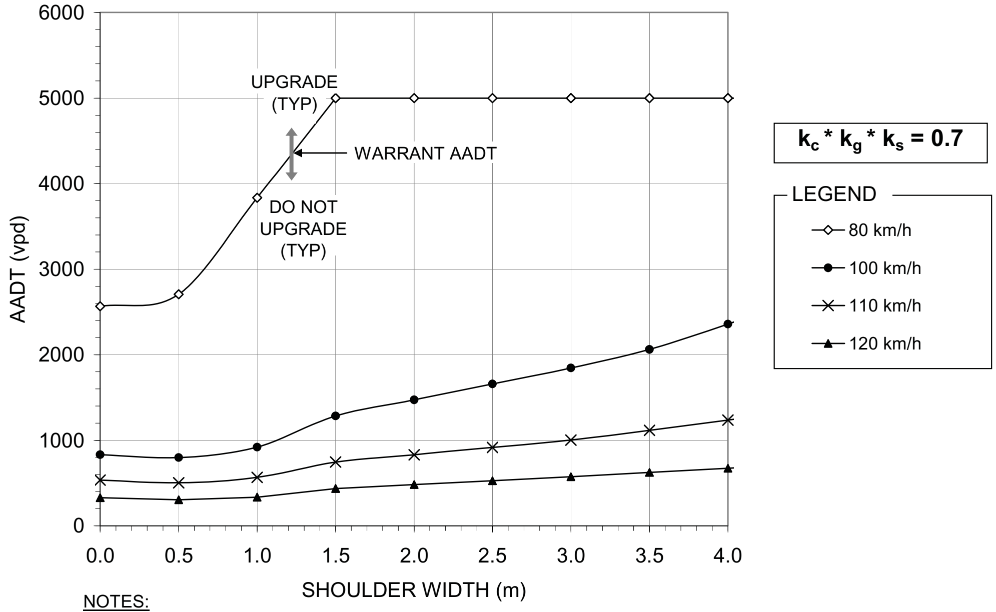
FIGURE HD1.4B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "850 mm DOUBLE TUBE" TYPE BRIDGERAIL - DIVIDED ROADWAYS (REFER TO STANDARD DRAWINGS S-1716-07 TO S-1719-07)



NOTES:

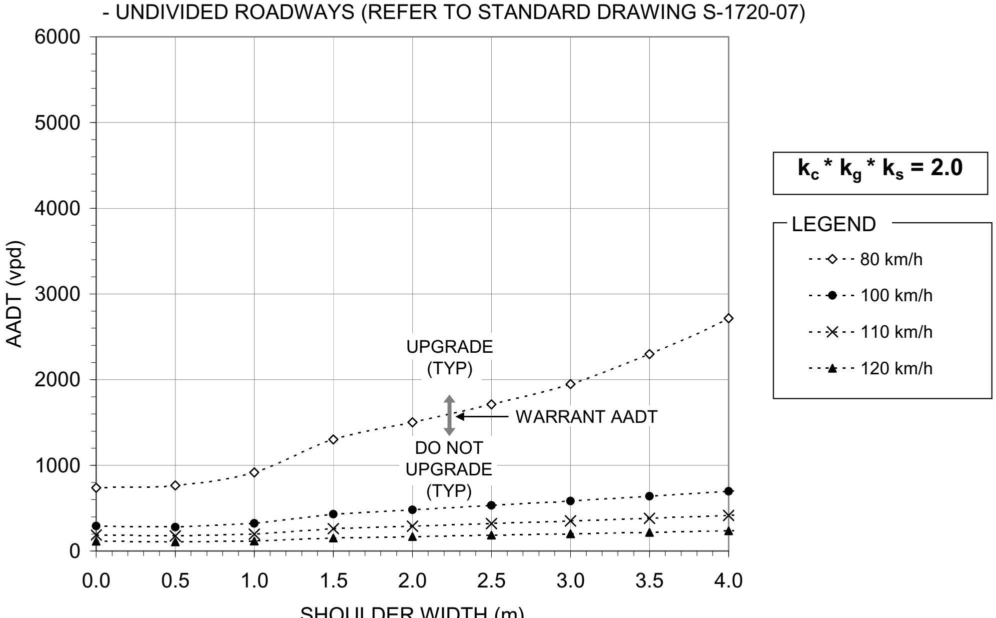
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 100 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.5A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 1 PARTICIPATING CURB - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



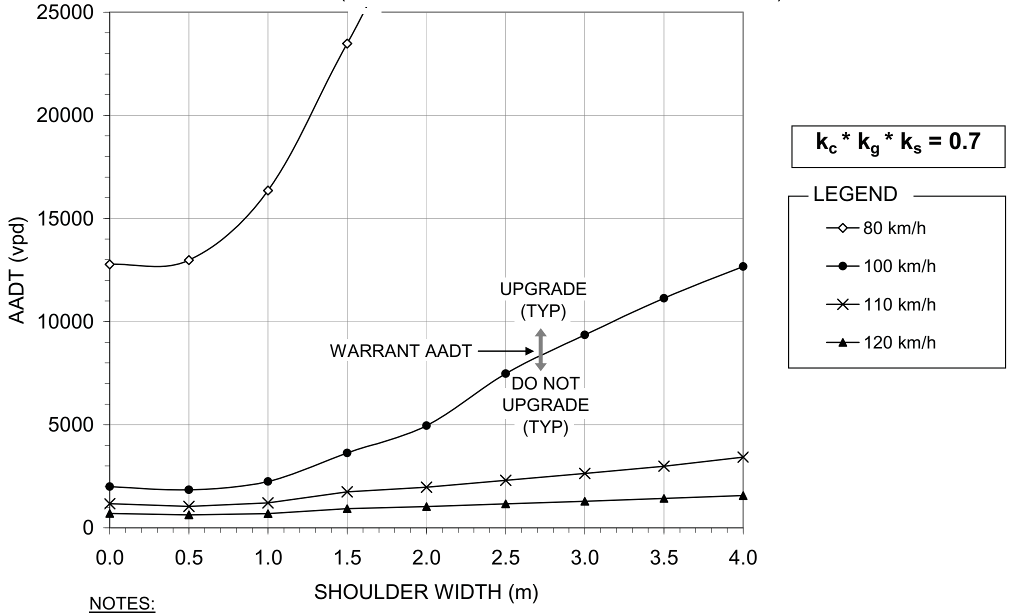
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.5B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 1 PARTICIPATING CURB - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



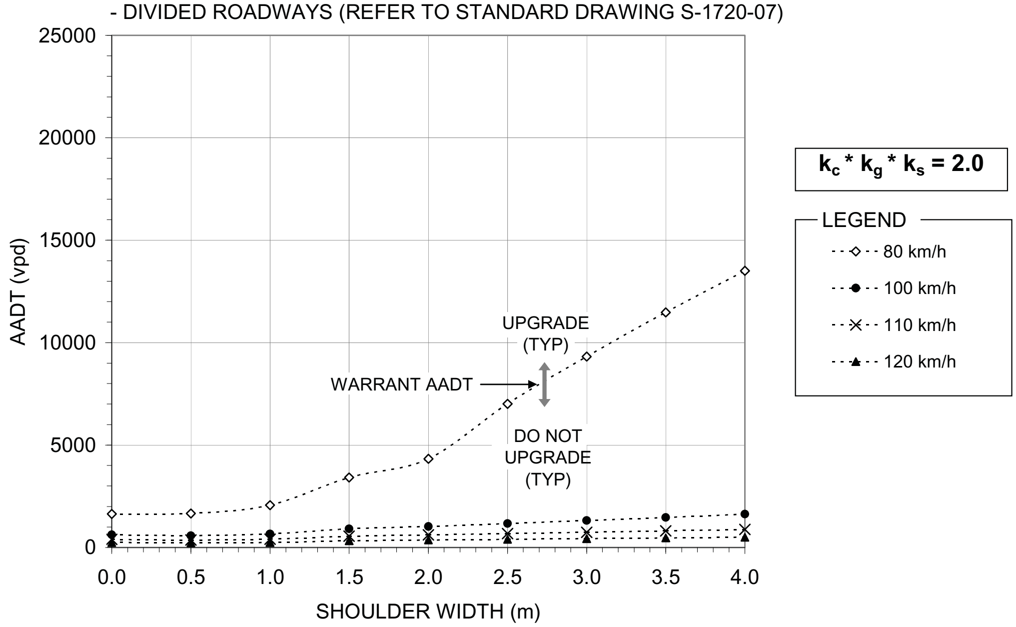
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.6A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 1 PARTICIPATING CURB - DIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



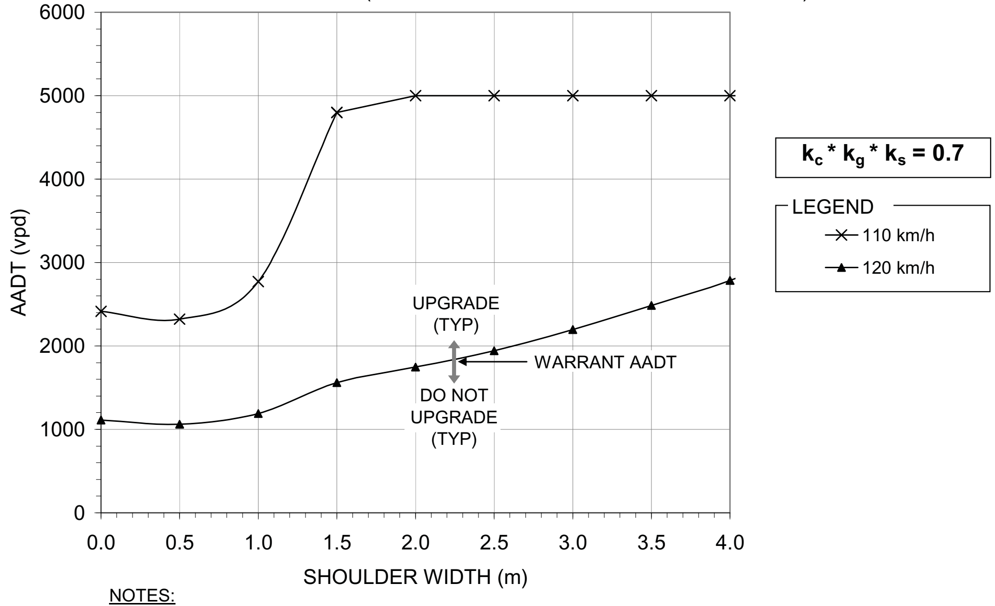
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.6B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 1 PARTICIPATING CURB - DIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



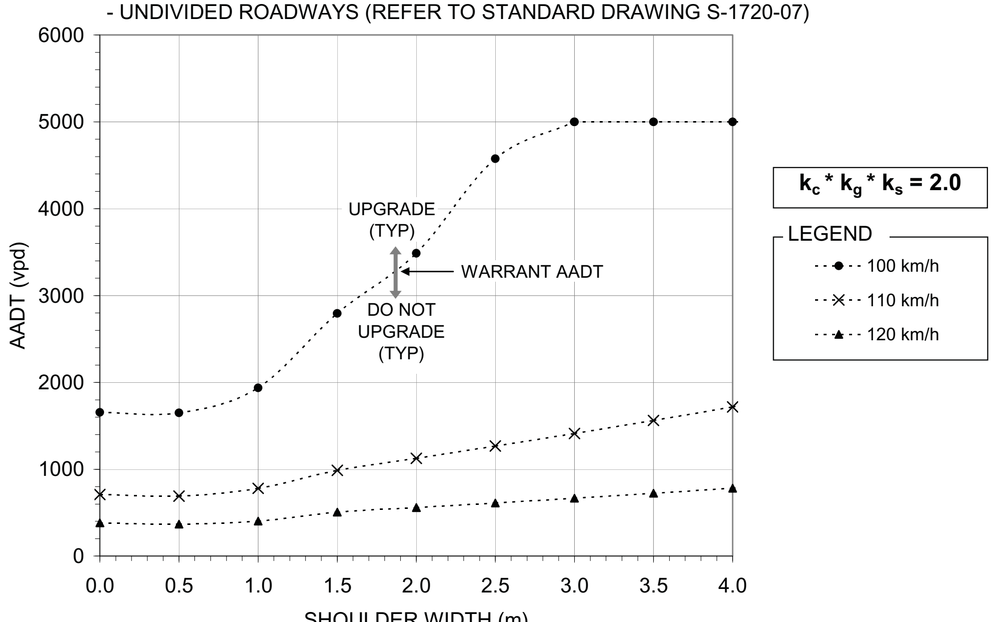
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.7A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "DOUBLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 2 PARTICIPATING CURB - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



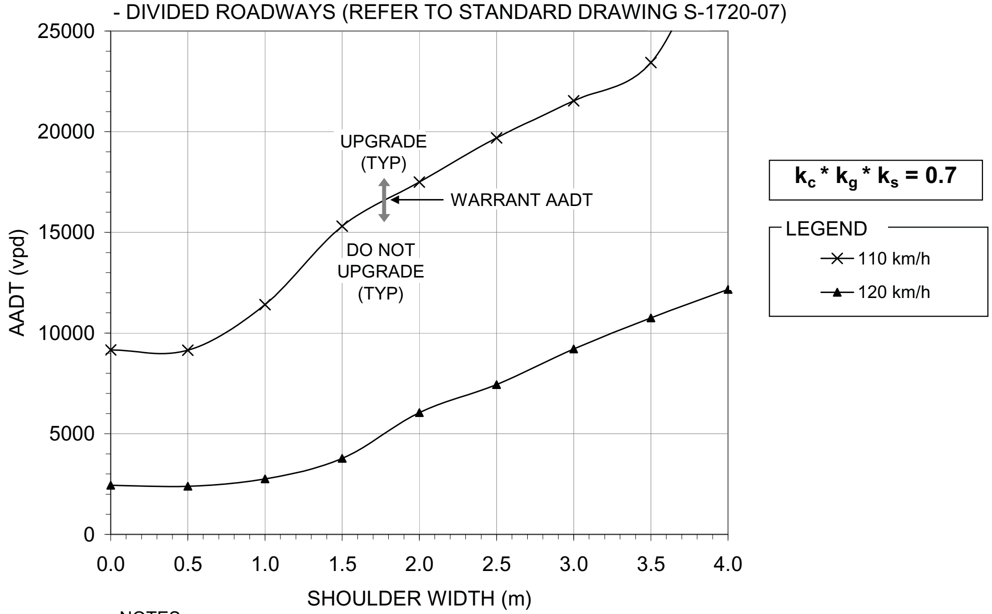
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 110 km/h.
- ASSUME A WARRANT AADT OF 5000 vpd FOR THE DESIGN SPEED OF 100 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.7A AND HD1.7B.
- FOR DOUBLE-LAYER DEEP BEAM TYPE BRIDGERAIL WITH 127 mm DIAMETER PIPE POST AT 1905 mm (MAX) SPACING ON TYPE 1 PARTICIPATING CURB, USE FIGURE HD1.5A.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.7B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "DOUBLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 2 PARTICIPATING CURB - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



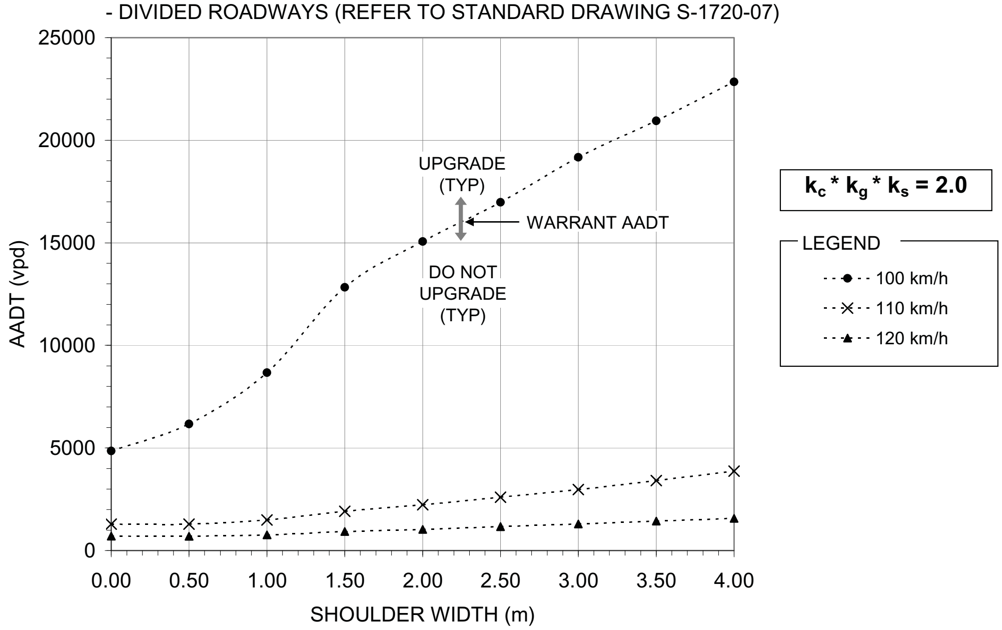
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 100 km/h.
- FOR DOUBLE-LAYER DEEP BEAM TYPE BRIDGERAIL WITH 127 mm DIAMETER STANDARD PIPE POST AT 1905 mm (MAX) SPACING ON TYPE 1 PARTICIPATING CURB, USE FIGURE HD1.5B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.8A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "DOUBLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 2 PARTICIPATING CURB - DIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



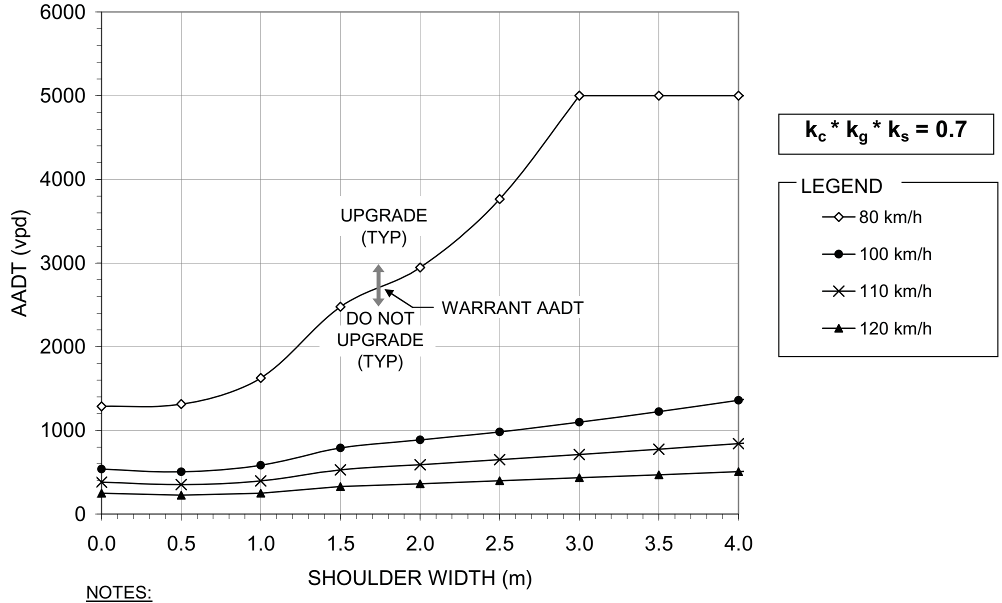
NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 110 km/h.
- ASSUME A WARRANT AADT OF 25000 vpd FOR THE DESIGN SPEED OF 100 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.8A AND HD1.8B.
- FOR DOUBLE-LAYER DEEP BEAM TYPE BRIDGERAIL WITH 127 mm DIAMETER PIPE POST AT 1905 mm (MAX) SPACING ON TYPE 1 PARTICIPATING CURB, USE FIGURE HD1.6A.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.8B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "DOUBLE LAYER DEEP BEAM (W-BEAM)" TYPE BRIDGERAIL ON TYPE 2 PARTICIPATING CURB - DIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



NOTES:
- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 100 km/h.
- FOR DOUBLE-LAYER DEEP BEAM TYPE BRIDGERAIL WITH 127 mm DIAMETER STANDARD PIPE POST AT 1905 mm (MAX) SPACING ON TYPE 1 PARTICIPATING CURB, USE FIGURE HD1.6B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

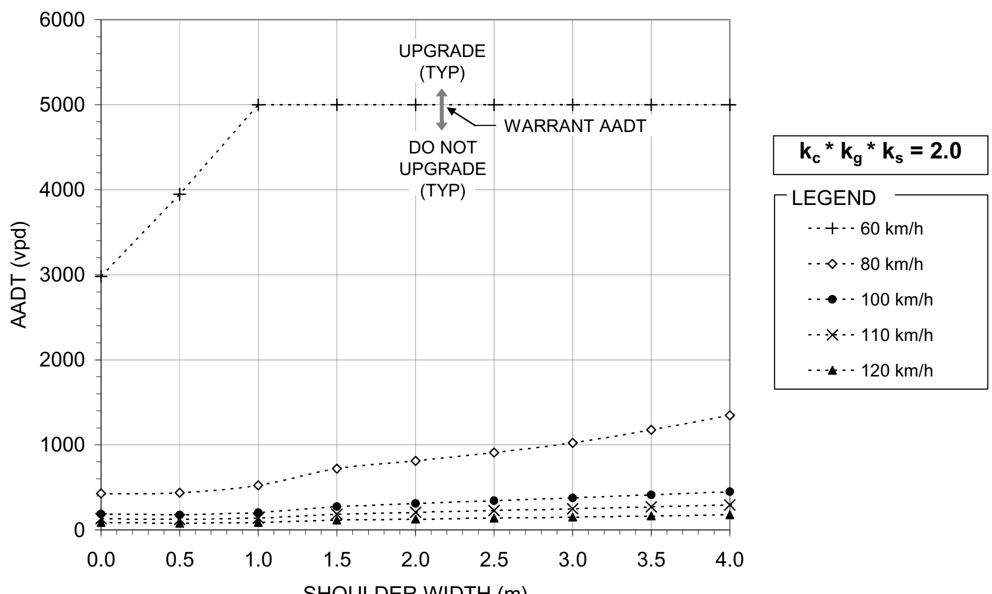
FIGURE HD1.9A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE OR DOUBLE LAYER DEEP BEAM" TYPE BRIDGERAIL ON SAFETY CURB - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



NOTES:

- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- ASSUME A WARRANT AADT OF 5000 vpd FOR THE DESIGN SPEED OF 60 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.9A AND HD1.9B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

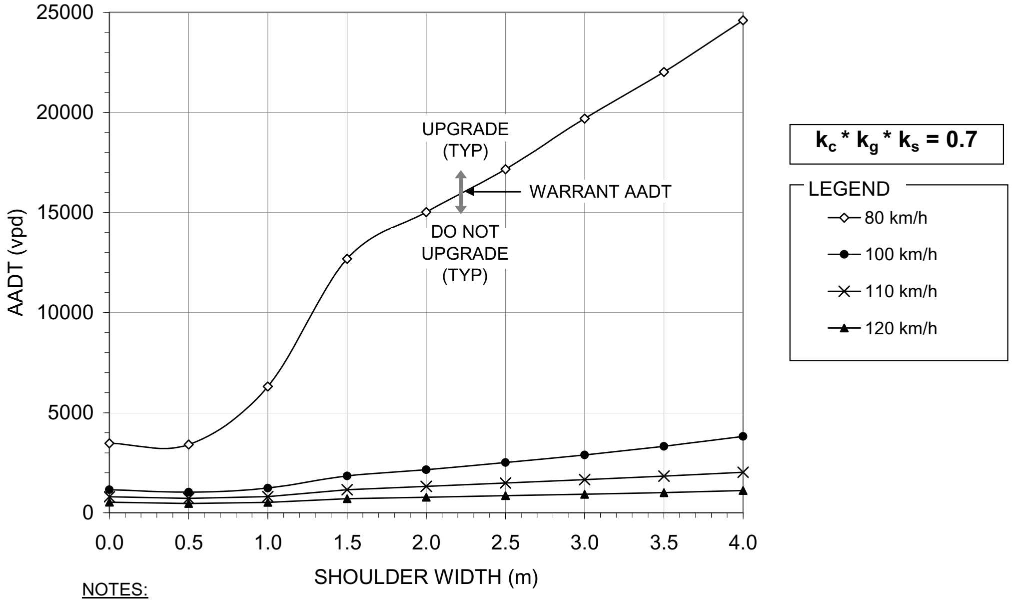
FIGURE HD1.9B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE OR DOUBLE LAYER DEEP BEAM" TYPE BRIDGERAIL ON SAFETY CURB - UNDIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



NOTES:

- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 60 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

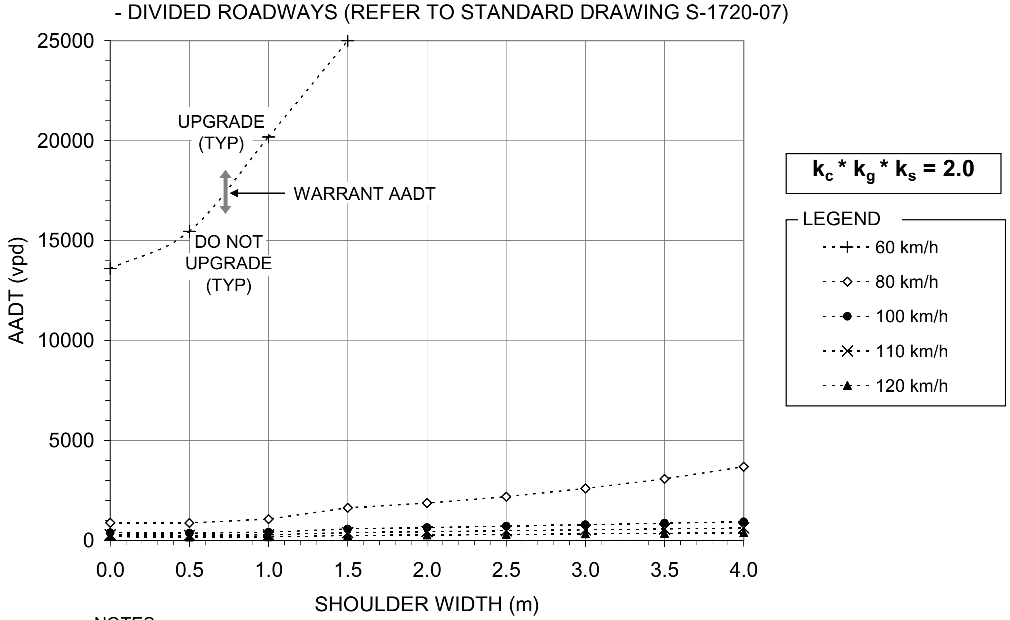
FIGURE HD1.10A: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE OR DOUBLE LAYER DEEP BEAM" TYPE BRIDGERAIL ON SAFETY CURB - DIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



NOTES:

- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 80 km/h.
- ASSUME A WARRANT AADT OF 25000 vpd FOR THE DESIGN SPEED OF 60 km/h FOR INTERPOLATION USE ONLY BETWEEN FIGURES HD1.10A AND HD1.10B.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

FIGURE HD1.10B: APPROACH RAIL TRANSITION UPGRADE WARRANTS FOR "SINGLE OR DOUBLE LAYER DEEP BEAM" TYPE BRIDGERAIL ON SAFETY CURB - DIVIDED ROADWAYS (REFER TO STANDARD DRAWING S-1720-07)



NOTES:

- UPGRADES ARE NOT WARRANTED FOR DESIGN SPEEDS LESS THAN 60 km/h.
- AADT IS THE TOTAL VOLUME OF TRAFFIC IN BOTH DIRECTIONS.

D1.3 EXAMPLES - UPGRADING EXISTING BRIDGE APPROACH RAIL TRANSITIONS

The three bridgerail upgrading examples from Appendix C1 are continued below to demonstrate the steps required to determine the Warrant AADT for upgrading the approach rail transitions. In the first example, the product of factors $k_c * k_g * k_s$ is greater than 2.0 which is outside the realm of the approach rail transition upgrading warrant charts. Therefore, the decision of whether or not to upgrade the approach rail transition is based on following the six step detailed warrant procedure. In the second example, the product of factors $k_c * k_g * k_s$ is equal to 0.70, allowing the warrant charts to be used directly. In the third example, the product of $k_c * k_g * k_s$ is between 0.7 and 2.0, and therefore the Warrant AADT is determined using linear interpolation between the warrant chart curves.

EXAMPLE 1 – BRIDGE #1
($k_c * k_g * k_s$ greater than 2.0)

<u>Bridge and Highway Data:</u>

- Refer to Example 1 in Appendix C1
- Refer to Standard Drawings S-1711-07 to S-1715-07 for approach rail upgrading details.

<u>Calculations:</u>

- k_c = 1.9 from Table HC1.2 (Appendix C1)
- k_g = 1.0 from Table HC1.3 (Appendix C1)
- k_s = 1.3 from Table HC1.6 (Appendix C1)
- Since the product $k_c * k_g * k_s$ is greater than 2.0, the need for approach rail transition upgrading must be determined using the detailed six step procedure.
    - Step 1 – Upgrading Costs
        - Cost to upgrade the approach rail transition is $16,400 per corner of bridge, in year 2000 dollars (Table HD1.1)
    - Step 2 – Severity Index (SI) and Corresponding Length (L)
        - SI of the upgraded approach rail transition is 3.1 (Table HD1.2)
        - SI of the existing approach rail transition is 5.6 with a corresponding length of 8.5 m (Figure HD2.1, Appendix D2)

- Step 3 – Collision Frequency
  - R = 0.53 based on linear interpolation with AADT = 1700 (Table HC1.1, Appendix C1)
  - P = 0.7965 based on linear interpolation with a shoulder width of 0.90 m at a design speed of 100 km/h (Table HC1.4, Appendix C1)
  - $F = R * k_c * k_g * P = 0.80$ encroachments/km/year
- Step 4 – Present Worth Collision Costs ($PWCC = F * k_s * AC * L * KC / 1000$)
  - AC1 (upgrade) = $78,000 based on linear interpolation (Table HC1.7, Appendix C1)
  - AC2 (no upgrade) = $265,000 (Table HC1.7, Appendix C1)
  - L = 8.5 m (Step 2)
  - KC = 16.252
  - PWCC1 (upgrade) = $11,200 collision costs per corner of bridge over 20 years
  - PWCC2 (no upgrade) = $38,100 collision costs per corner of bridge over 20 years
- Step 5 – Determining PWC1 and PWC2
  - PWC1 = $16,400 (approach rail transition upgrade cost per corner of bridge) plus $11,200 (collision costs of the upgraded approach rail transition per corner of bridge over 20 years) = $27,600
  - PWC2 = $38,100 (collision costs of the existing approach rail transition per corner of bridge over 20 years)

Conclusion: Since PWC1 (upgrade) < PWC2 (no upgrade), upgrading the approach rail transition at each corner of the bridge is warranted.

- Step 6 (OPTIONAL) – Iterating to Solve for the "Warrant AADT"
  - The table below summarizes the trial and error results of determining the Warrant AADT:

Assumed Warrant AADT	PWC1 (upgrade)	PWC2 (no upgrade)
600	$ 20,700	$ 14,700
700	$ 21,400	$ 17,100
800	$ 22,200	$ 19,600
900	$ 22,900	$ 22,000
950	$ 23,200	$ 23,300
952	$ 23,300	$ 23,300

Therefore the Warrant AADT is 952 vpd.

<u>Conclusion:</u>
Since the actual AADT of 1700 vpd > the Warrant AADT of 952 vpd, upgrading of the approach rail transition is warranted at each corner of the bridge.

Note that in Example 1 in Appendix C1, it was determined that the bridgerail should be upgraded. Therefore, the approach rail transition would be upgraded by default, regardless of the conclusion noted above.

EXAMPLE 2 – BRIDGE #2
(k_c * k_g * k_s equal to 0.70)

<u>Bridge and Highway Data:</u>

- Refer to Example 2 in Appendix C1
- Refer to Standard Drawings S-1720-07 for approach rail upgrading details.

<u>Calculations:</u>

- k_c = 1.0 from Table HC1.2 (Appendix C1)
- k_g = 1.0 from Table HC1.3 (Appendix C1)
- k_s = 0.70 Table HC1.6 (Appendix C1)
- Since the product $k_c * k_g * k_s$ is equal to 0.70, the Warrant Chart in Figure HD1.9A may be used directly.
- From Figure HD1.9A, the "Warrant AADT" corresponding to a shoulder width of 1.8 m and a design speed of 100 km/h is approximately 920 vpd.

<u>Conclusion:</u>

Since the actual AADT of 2500 vpd > the Warrant AADT of 920 vpd, upgrading of the approach rail transition is warranted at each corner of the bridge.

Note that in Example 2 in Appendix C1, it was determined that the bridgerail should not be upgraded. However, upgrading of the approach rail transition is still required.

EXAMPLE 3 – BRIDGE #3
(k_c * k_g * k_s between 0.70 and 2.0)

Bridge and Highway Data:

- Refer to Example 3 in Appendix C1
- Refer to Standard Drawings S-1716-07 to S-1719-07 for approach rail upgrading details.

Calculations:

- k_c = 1.0 from Table HC1.2 (Appendix C1)
- k_g = 1.0 from Table HC1.3 (Appendix C1)
- k_s = 0.88 from Table HC1.6 (Appendix C1)
- Since the product k_c * k_g * k_s is between 0.70 and 2.0, the Warrant AADT may be determined by linearly interpolating between the warrant charts in Figures HD1.4A and HD1.4B.
  - From Figure HD1.4A, the Warrant AADT corresponding to a shoulder width of 2.5 m and a design speed of 110 km/h is 25,000 vpd for k_c * k_g * k_s = 0.7.
  - From Figure HD1.4B, the Warrant AADT corresponding to a shoulder width of 2.5 m and a design speed of 110 km/h is 13,800 vpd for k_c * k_g * k_s = 2.0.
  - Using linear interpolation, the Warrant AADT is calculated as follows:

Warrant AADT = 25,000 vpd + (0.88 – 0.70) * [(13,800 vpd – 25,000 vpd) / (2.0 – 0.70)]
= 23,450 vpd

Conclusion:

Since the actual AADT of 9,900 vpd < the Warrant AADT of 23,450 vpd, upgrading of the approach rail transition is NOT warranted.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D2

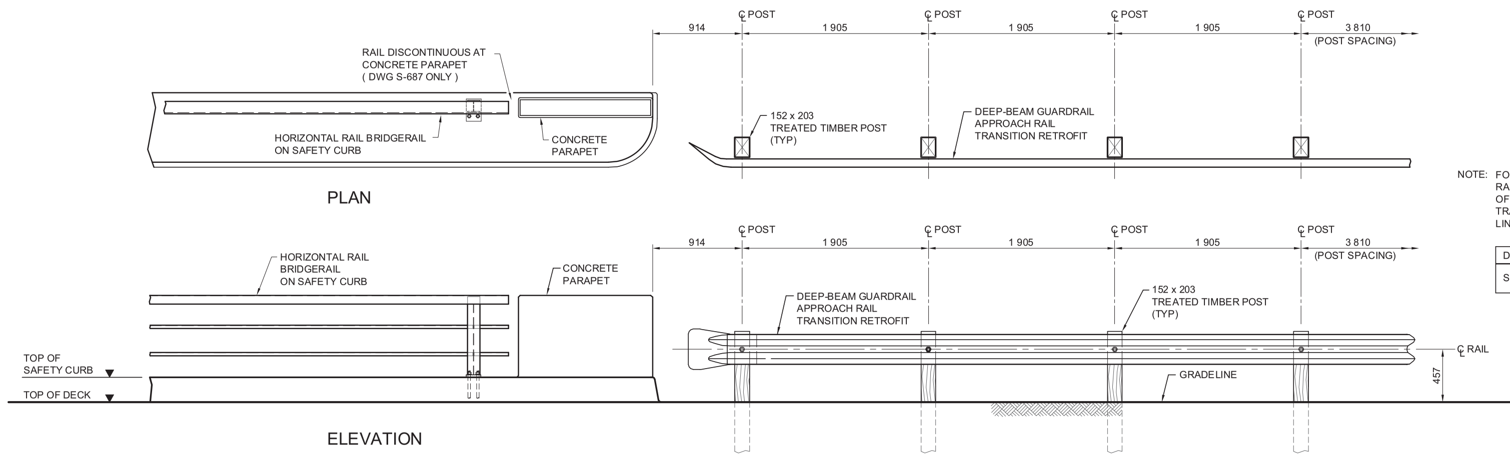
EXISTING INFTRA BRIDGE APPROACH RAIL TRANSITIONS AND CORRESPONDING SEVERITY INDICES

THIS PAGE LEFT INTENTIONALLY BLANK

Appendix D2
Existing INFTRA Bridge Approach Rail Transitions and Corresponding Severity Indices

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

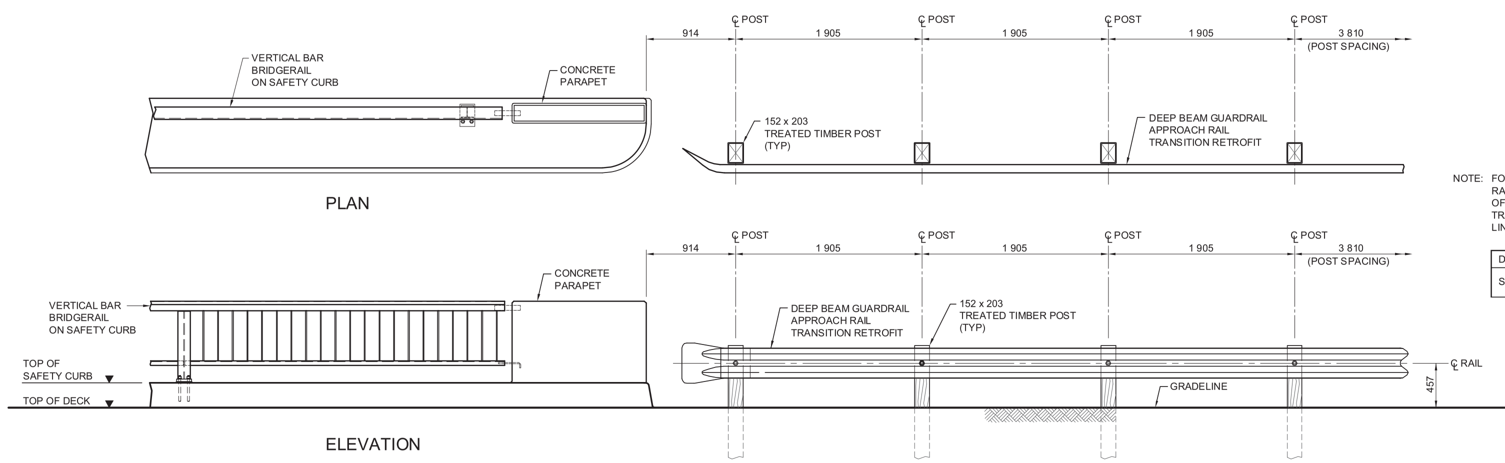


NOTE: FOR UPSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF CURB (SHOWN). FOR DOWNSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF BRIDGERAIL.

DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	5.4m @ 2.2	5.8m @ 2.6	6.8m @ 4.6	8.5m @ 5.6	9.9m @ 6.0	11.4m @ 6.6

(a) HORIZONTAL RAIL BRIDGERAIL ON SAFETY CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-687 AND S-974-69)



NOTE: FOR UPSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF CURB (SHOWN). FOR DOWNSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF BRIDGERAIL.

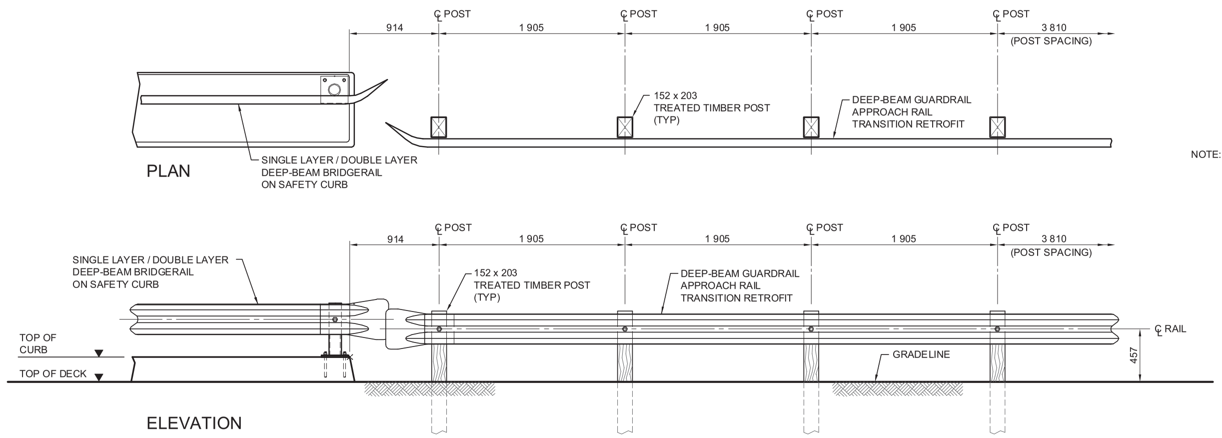
DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	5.4m @ 2.2	5.8m @ 2.6	6.8m @ 4.6	8.5m @ 5.6	9.9m @ 6.0	11.4m @ 6.6

(b) VERTICAL BAR BRIDGERAIL ON SAFETY CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-732 AND S-974-69)

EXISTING ALBERTA TRANSPORTATION APPROACH RAIL TRANSITIONS

FIGURE HD2.1

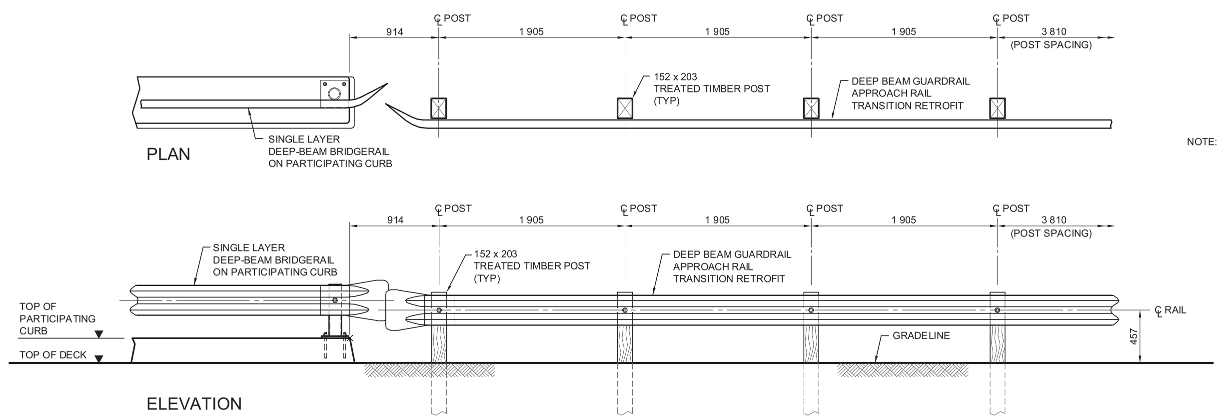


NOTE: FOR UPSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF CURB (SHOWN). FOR DOWNSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF BRIDGERAIL.

DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	5.4m @ 2.2	5.8m @ 2.6	6.8m @ 4.6	8.5m @ 5.6	9.9m @ 6.0	11.4m @ 6.6

(c) SINGLE LAYER / DOUBLE LAYER DEEP-BEAM BRIDGERAIL ON SAFETY CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-659-69, S675-69 AND S-974-69)



NOTE: FOR UPSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF CURB (SHOWN). FOR DOWNSTREAM TRAFFIC, APPROACH RAIL TRANSITION LINES UP WITH FACE OF BRIDGERAIL.

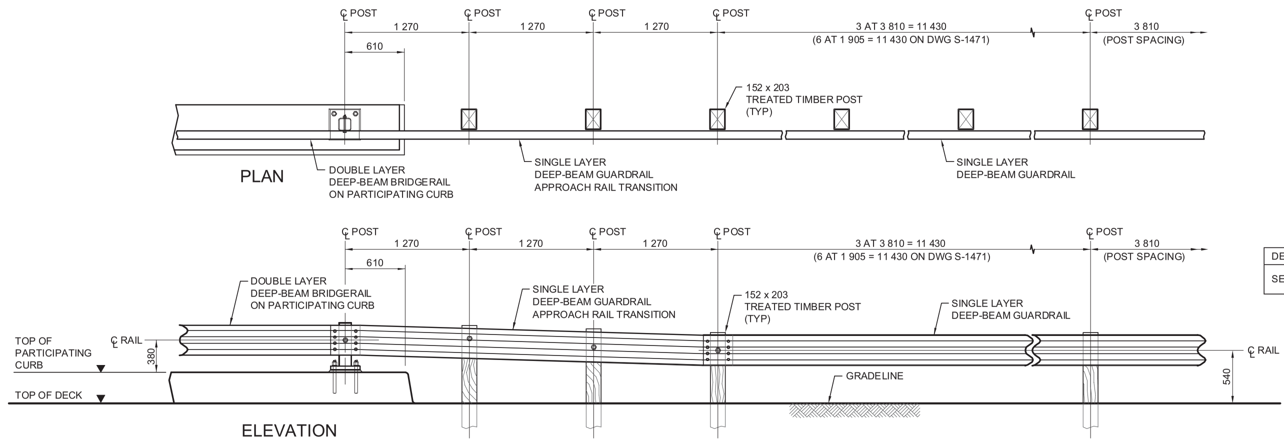
DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	2.4m @ 2.2	2.8m @ 2.6	3.8m @ 4.6	5.5m @ 5.6	6.9m @ 6.0	8.4m @ 6.6

(d) SINGLE LAYER DEEP-BEAM BRIDGERAIL ON PARTICIPATING CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-659-69, S-675-69 AND S-974-69)

EXISTING ALBERTA TRANSPORTATION APPROACH RAIL TRANSITIONS

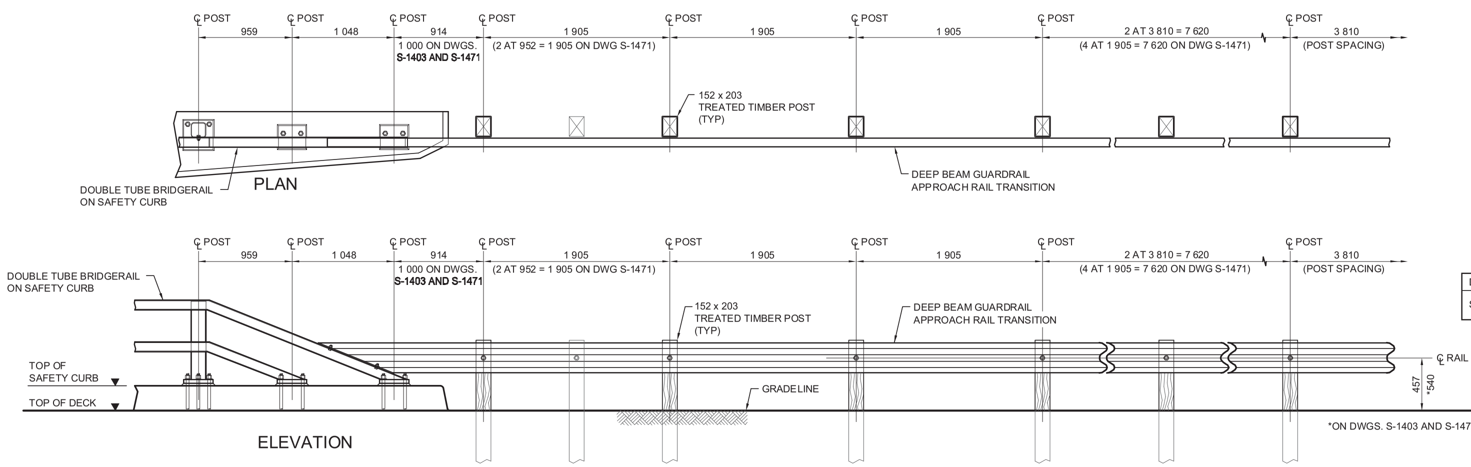
FIGURE HD2.2



DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	0.4m @ 2.0	0.7m @ 2.2	1.5m @ 3.2	2.7m @ 4.5	3.5m @ 5.0	4.2m @ 5.6

(e) DOUBLE LAYER DEEP-BEAM BRIDGERAIL ON PARTICIPATING CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-1402 AND S-1403)



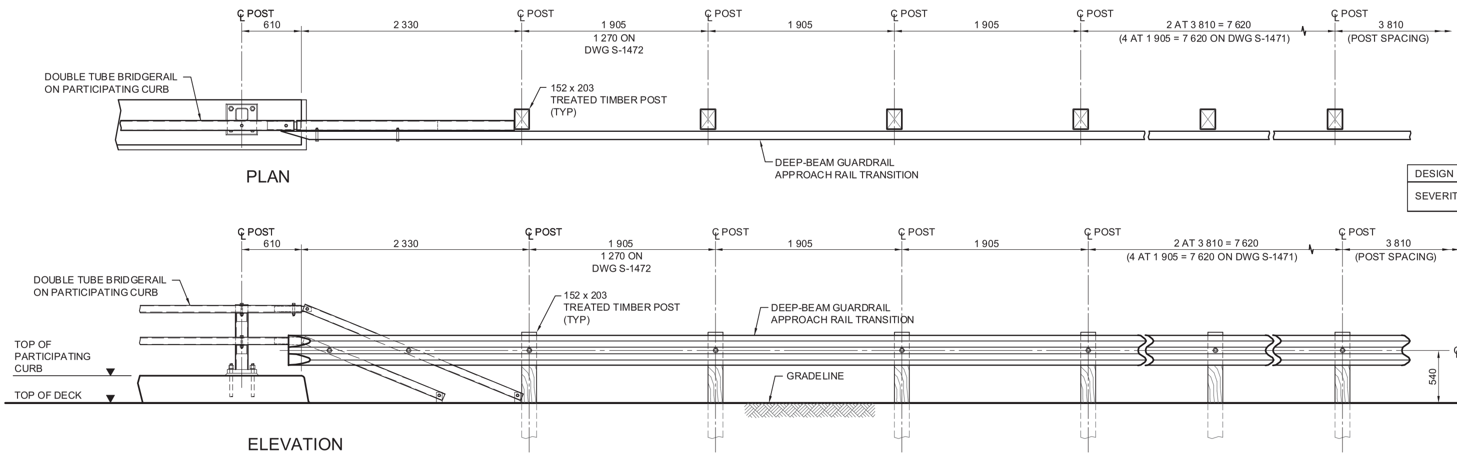
DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	1.9m @ 2.0	2.2m @ 2.2	3.0m @ 3.2	4.2m @ 4.5	5.0m @ 5.0	5.7m @ 5.6

(f) DOUBLE TUBE BRIDGERAIL ON SAFETY CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-986-69 AND S-974-69)

EXISTING ALBERTA TRANSPORTATION APPROACH RAIL TRANSITIONS

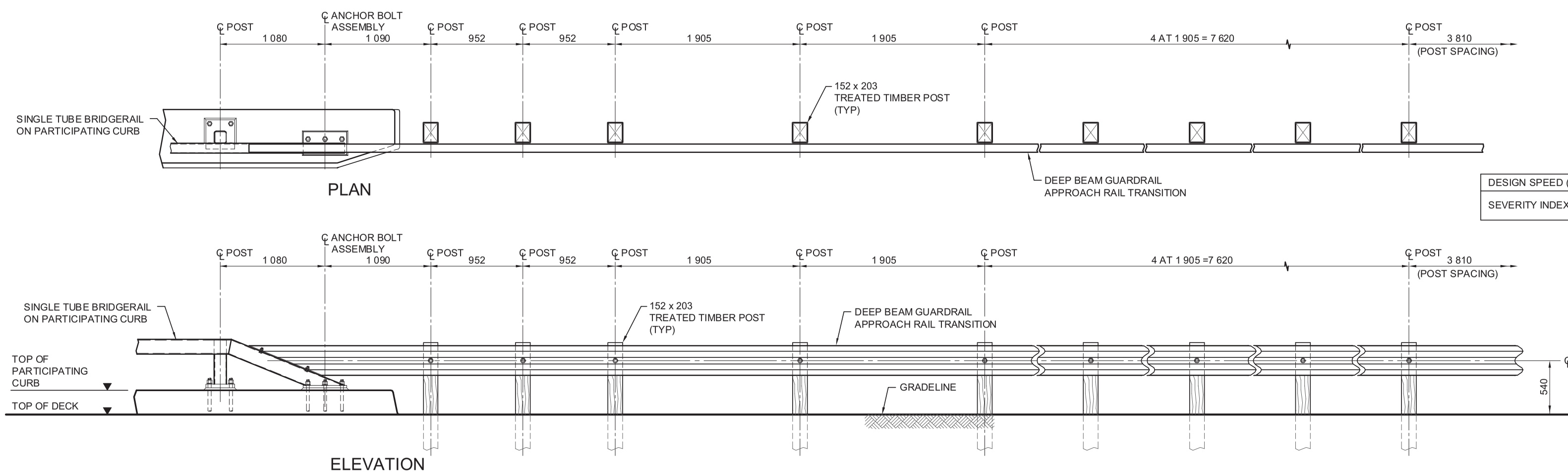
FIGURE HD2.3



DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	0.4m @ 2.0	0.7m @ 2.2	1.5m @ 3.2	2.7m @ 4.5	3.5m @ 5.0	4.2m @ 5.6

(g) DOUBLE TUBE BRIDGERAIL ON PARTICIPATING CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-1402 AND S-1403)



DESIGN SPEED (km/h)	50	60	80	100	110	120
SEVERITY INDEX	0.4m @ 2.0	0.7m @ 2.2	1.5m @ 3.2	2.7m @ 4.5	3.5m @ 5.0	4.2m @ 5.6

(h) SINGLE TUBE BRIDGERAIL ON PARTICIPATING CURB APPROACH RAIL TRANSITION

(DETAILS SHOWN ARE BASED ON DWGS. S-1618-95 AND S-1471)

EXISTING ALBERTA TRANSPORTATION APPROACH RAIL TRANSITIONS

FIGURE HD2.4

APPENDIX D3

INFTRA STANDARD DRAWINGS
FOR UPGRADING OF EXISTING BRIDGE
APPROACH RAIL TRANSITIONS

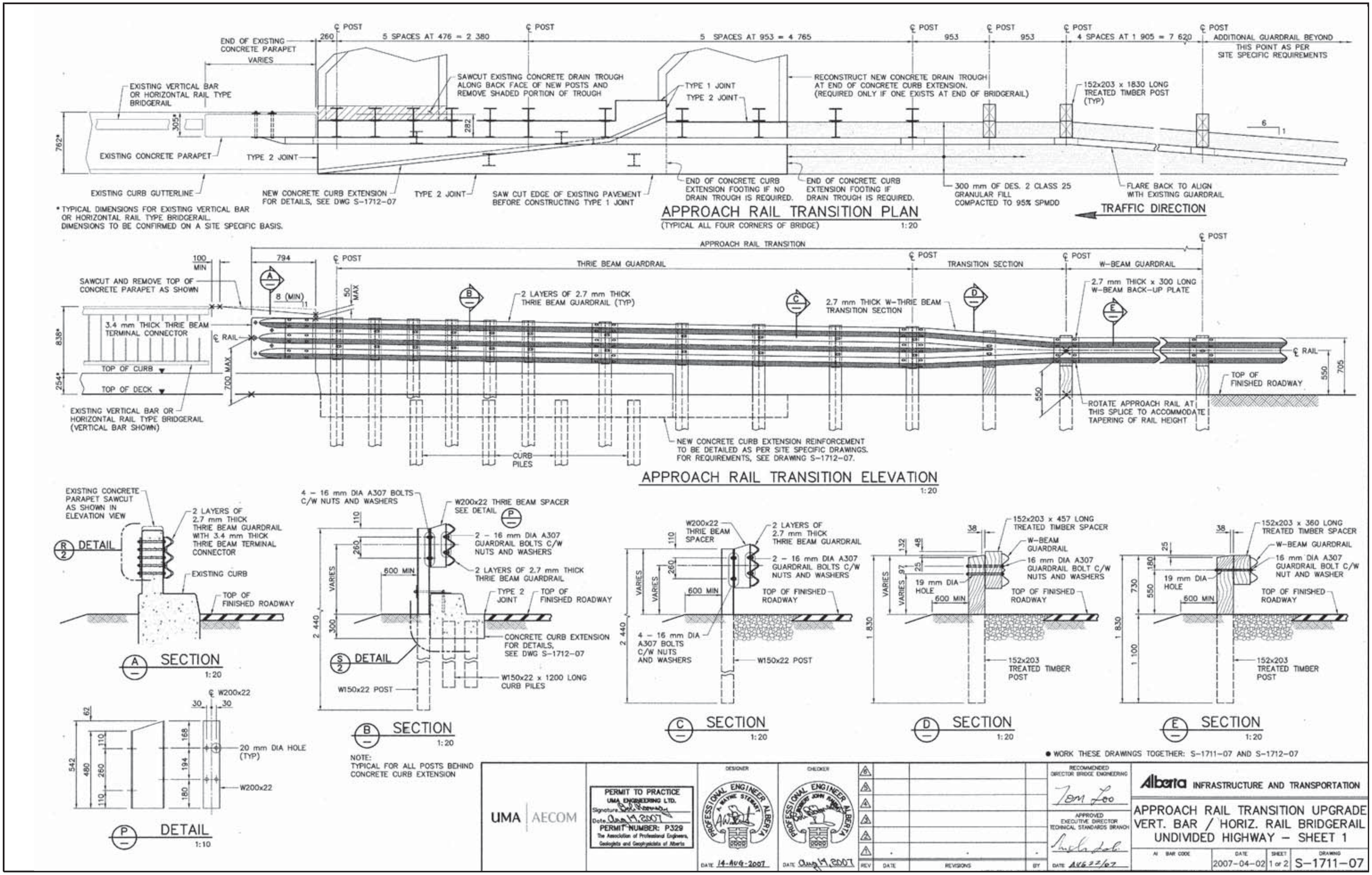
THIS PAGE LEFT INTENTIONALLY BLANK

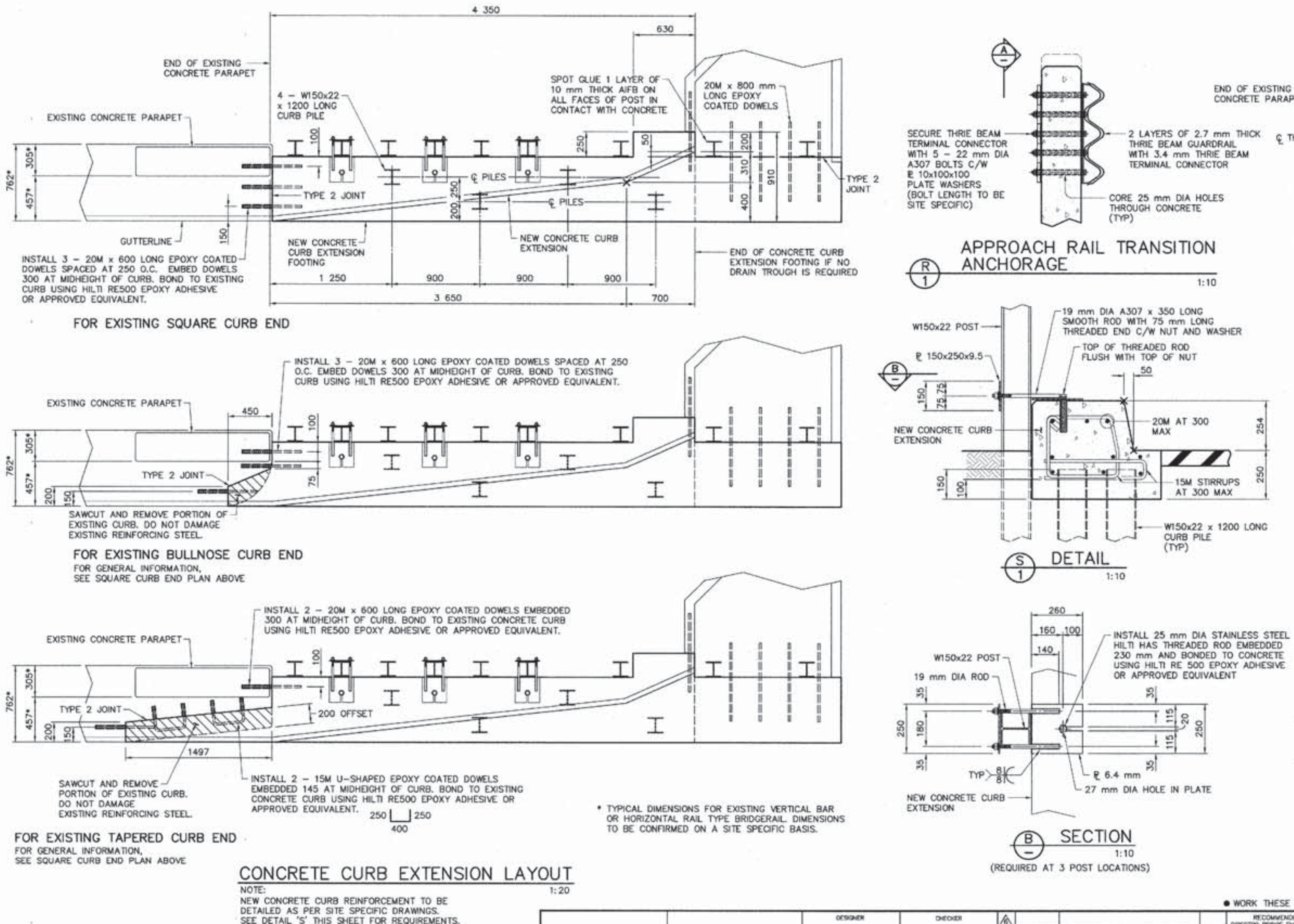
Appendix D3

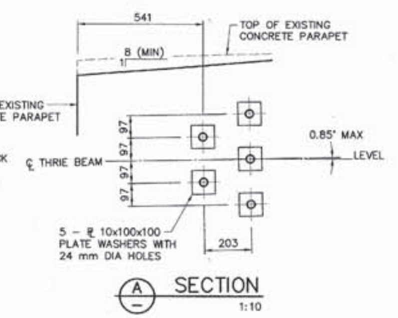
INFTRA Standard Drawings for Upgrading of Existing Bridge Approach Rail Transitions

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK


APPROACH RAIL TRANSITION PLAN
(TYPICAL ALL FOUR CORNERS OF BRIDGE) 1:20
TRAFFIC DIRECTION
APPROACH RAIL TRANSITION ELEVATION 1:20
SECTION A 1:20
SECTION B 1:20
SECTION C 1:20
SECTION D 1:20
SECTION E 1:20
DETAIL P 1:10
DETAIL R/2
DETAIL S/2
NOTE: TYPICAL FOR ALL POSTS BEHIND CONCRETE CURB EXTENSION
* TYPICAL DIMENSIONS FOR EXISTING VERTICAL BAR OR HORIZONTAL RAIL TYPE BRIDGERAIL. DIMENSIONS TO BE CONFIRMED ON A SITE SPECIFIC BASIS.
● WORK THESE DRAWINGS TOGETHER: S-1711-07 AND S-1712-07
UMA AECOM
PERMIT TO PRACTICE UMA ENGINEERING LTD. PERMIT NUMBER: P329
Alberta INFRASTRUCTURE AND TRANSPORTATION
APPROACH RAIL TRANSITION UPGRADE
VERT. BAR / HORIZ. RAIL BRIDGERAIL
UNDIVIDED HIGHWAY – SHEET 1
DATE 2007-04-02
SHEET 1 of 2
DRAWING S-1711-07





GENERAL NOTES

1. THESE APPROACH RAIL TRANSITION UPGRADE DRAWINGS APPLY TO VERTICAL BAR BRIDGERAILS SIMILAR TO THE BRIDGERAIL SHOWN ON DRAWING S–732 AND ALSO TO HORIZONTAL RAIL TYPE BRIDGERAILS SIMILAR TO THE BRIDGERAIL SHOWN ON DRAWING S–687.
2. THESE APPROACH RAIL TRANSITION UPGRADE DRAWINGS ONLY APPLY WHEN UPGRADING OF THE BRIDGERAIL IS NOT BEING CARRIED OUT.
3. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.

FABRICATION

1. APPROACH RAIL TRANSITION SHALL CONFORM TO THE CURRENT REQUIREMENTS OF THE SPECIFICATIONS FOR BRIDGE CONSTRUCTION SECTION 14 – GUARDRAIL.
2. ALL PLATE STEEL AND STRUCTURAL SHAPES SHALL CONFORM TO CSA G40.21 GRADE 300W, OR ASTM A36.
3. ALL BOLTS SHALL CONFORM TO ASTM A325 UNLESS NOTED OTHERWISE.
4. ALL W–BEAM AND THRIE BEAM GUARDRAIL (INCLUDING THRIE BEAM TERMINAL CONNECTOR AND W–THRIE BEAM TRANSITION SECTION) SHALL HAVE A MINIMUM YIELD STRENGTH OF 345 MPa.
5. TIMBER POSTS AND SPACERS SHALL BE COAST DOUGLAS FIR OR PACIFIC COAST HEMLOCK CONFORMING TO THE STRESS GRADE "SELECT STRUCTURAL POSTS AND TIMBERS" (NLGA PARAGRAPH 131 a).
6. ALL WELDING SHALL CONFORM TO CURRENT AWS SPECIFICATION DI.5.
7. ALL NON–STAINLESS STEEL MATERIALS SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH CSA G164 UNLESS NOTED OTHERWISE.
8. ALL CONCRETE SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 35 MPa.
9. ALL CONCRETE CORNERS SHALL HAVE A 20 mm CHAMFER OR FILLET UNLESS NOTED OTHERWISE.
10. ALL REINFORCING STEEL SHALL HAVE A MINIMUM 75 mm CLEAR COVER UNLESS NOTED OTHERWISE.
11. ALL REINFORCING STEEL SHALL HAVE A MINIMUM YIELD STRENGTH OF 400 MPa.
12. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

ERECTION

1. LINE AND ELEVATION OF BARRIER SHALL BE SET BY INSTRUMENT.
2. ALL POSTS SHALL BE VERTICAL.
3. ALL RAIL SECTIONS SHALL BE LAPPED IN THE DIRECTION OF TRAFFIC.
4. ALL GALVANIZED MATERIAL CUT OR DAMAGED IN THE FIELD SHALL BE TOUCHED UP WITH TWO COATS OF ZINC RICH PAINT.

● WORK THESE DRAWINGS TOGETHER: S–1711–07 AND S–1712–07

UMA | AECOM

PERMIT TO PRACTICE
UMA ENGINEERING LTD.
Signature
Date Aug 14, 2007
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

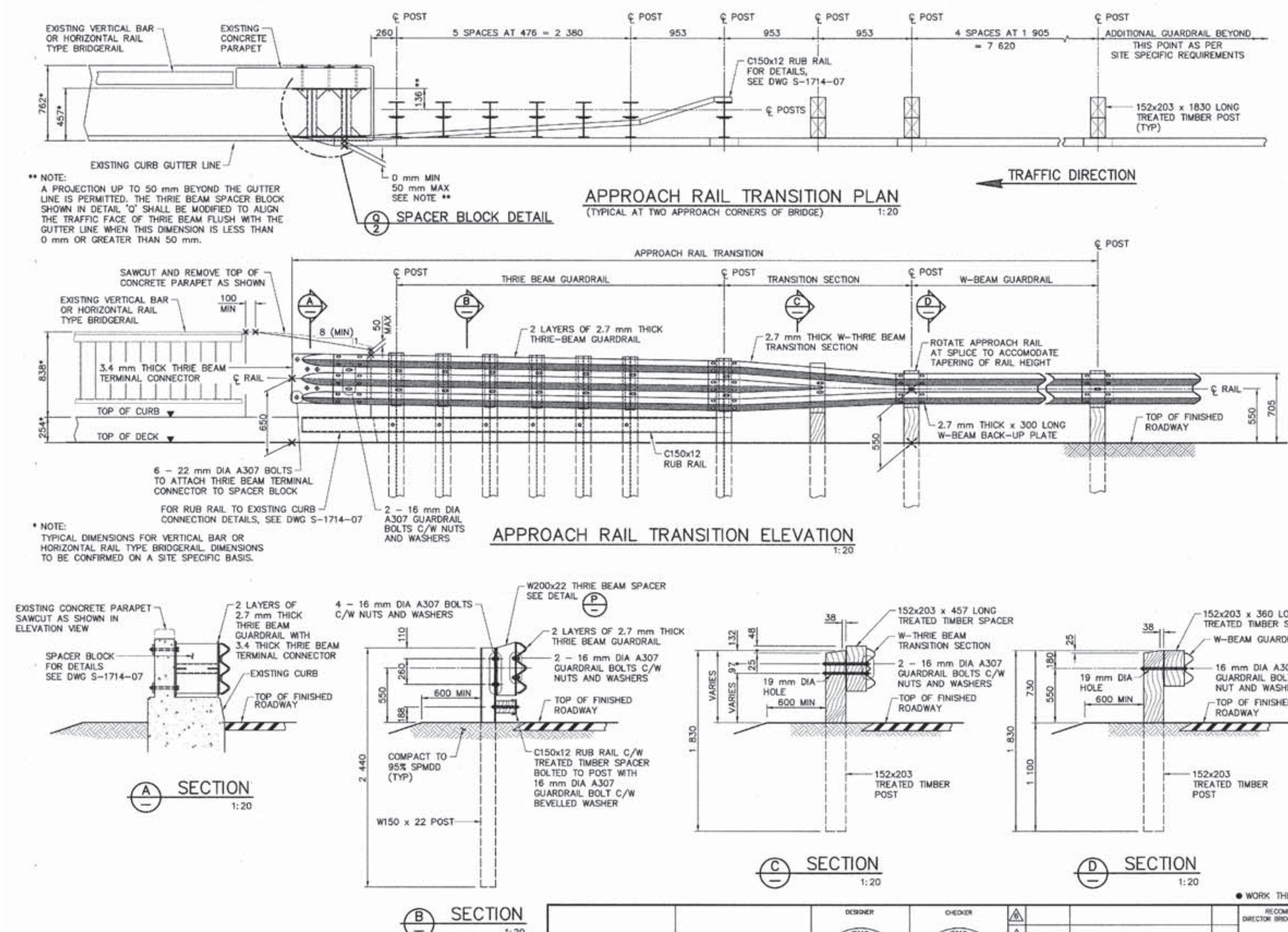
DESIGNER — DATE 14-AUG-2007
CHECKER — DATE Aug 14, 2007

RECOMMENDED DIRECTOR BRIDGE ENGINEERING — Tom Loo
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH — DATE AUG 22/07

Alberta INFRASTRUCTURE AND TRANSPORTATION

APPROACH RAIL TRANSITION UPGRADE
VERT. BAR / HORIZ. RAIL BRIDGERAIL
UNDIVIDED HIGHWAY – SHEET 2

BAR CODE	DATE	SHEET	DRAWING
	2007-04-02	2 of 2	S–1712–07



GENERAL NOTES

1. THESE APPROACH RAIL TRANSITION UPGRADE DRAWINGS APPLY TO VERTICAL BAR BRIDGERAILS SIMILAR TO THE BRIDGERAIL SHOWN ON DRAWING S-732 AND ALSO TO HORIZONTAL RAIL TYPE BRIDGERAILS SIMILAR TO THE BRIDGERAIL SHOWN ON DRAWING S-687.
2. THESE APPROACH RAIL TRANSITION UPGRADE DRAWINGS ONLY APPLY WHEN UPGRADING OF THE BRIDGERAIL IS NOT BEING CARRIED OUT.
3. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.

FABRICATION

1. APPROACH RAIL TRANSITION SHALL CONFORM TO THE CURRENT REQUIREMENTS OF THE SPECIFICATIONS FOR BRIDGE CONSTRUCTION SECTION 14 – GUARDRAIL.
2. ALL PLATE STEEL AND STRUCTURAL SHAPES SHALL CONFORM TO CSA G40.21 GRADE 300W, OR ASTM A36 EXCEPT STRUCTURAL TUBING SHALL CONFORM TO ASTM A500B.
3. ALL BOLTS SHALL CONFORM TO ASTM A325 UNLESS NOTED OTHERWISE.
4. ALL W-BEAM AND THRIE BEAM GUARDRAIL (INCLUDING THRIE BEAM TERMINAL CONNECTOR AND W-THRIE BEAM TRANSITION SECTION) SHALL HAVE A MINIMUM YIELD STRENGTH OF 345 MPa.
5. TIMBER POSTS AND SPACERS SHALL BE COAST DOUGLAS FIR OR PACIFIC COAST HEMLOCK CONFORMING TO THE STRESS GRADE "SELECT STRUCTURAL POSTS AND TIMBERS" (NLGA PARAGRAPH 131 a).
6. ALL WELDING SHALL CONFORM TO CURRENT AWS SPECIFICATION DI.5.
7. ALL NON-STAINLESS STEEL MATERIALS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH CSA G164 UNLESS NOTED OTHERWISE.

ERECTION

1. LINE AND ELEVATION OF BARRIER SHALL BE SET BY INSTRUMENT.
2. ALL POSTS SHALL BE VERTICAL.
3. ALL RAIL SECTIONS SHALL BE LAPPED IN THE DIRECTION OF TRAFFIC.
4. ALL GALVANIZED MATERIAL CUT OR DAMAGED IN THE FIELD SHALL BE TOUCHED UP WITH TWO COATS OF ZINC RICH PAINT.

● WORK THESE DRAWINGS TOGETHER: S-1713-07, S-1714-07 AND S-1715-07

UMA | AECOM

PERMIT TO PRACTICE
UMA ENGINEERING LTD.
Signature
Date Aug 14 2007
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

DESIGNER — DATE 14-AUG-2007
CHECKER — DATE Aug 14 2007

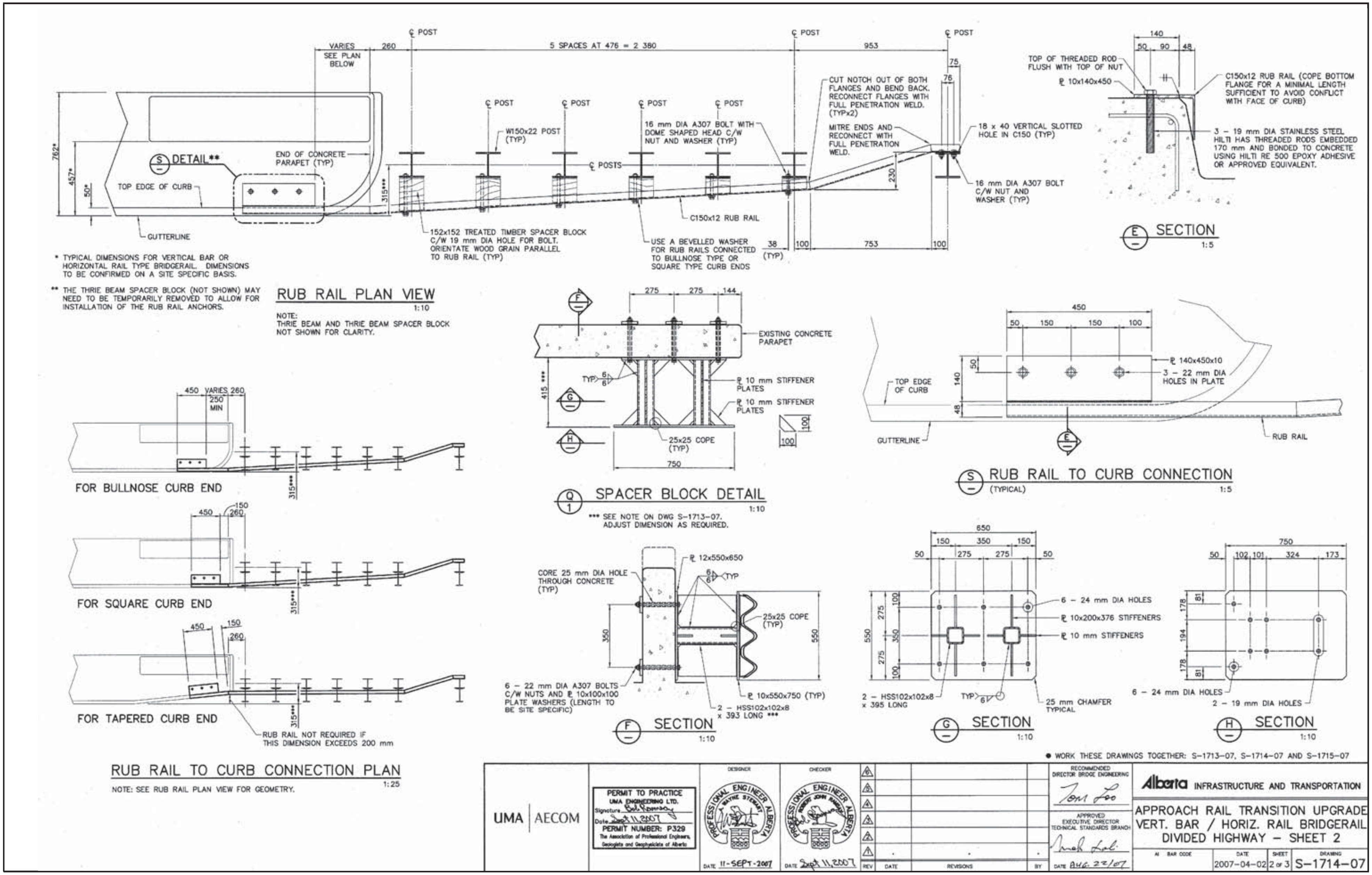
REV | DATE | REVISIONS | BY

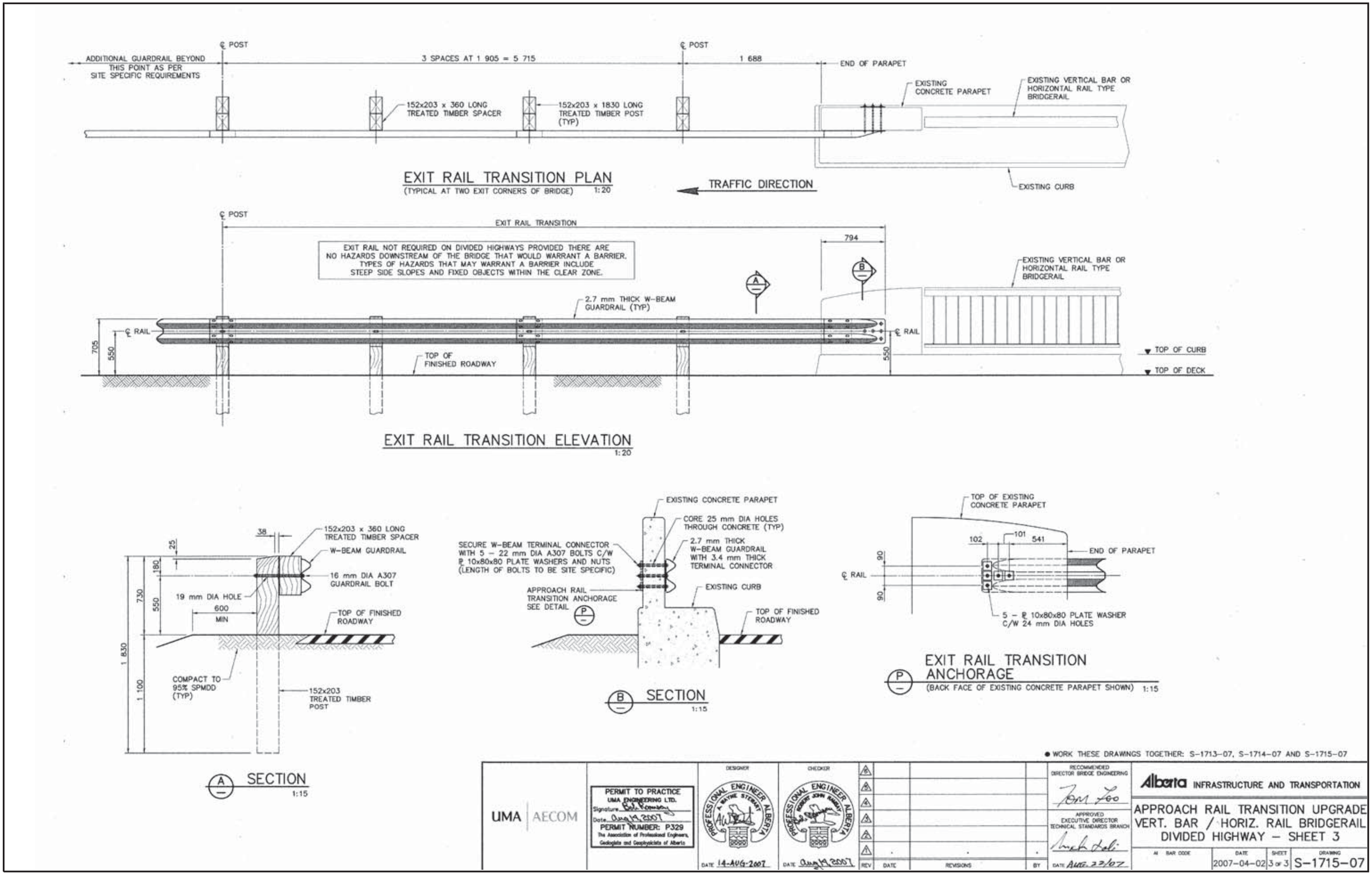
RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
DATE AUG. 22/07

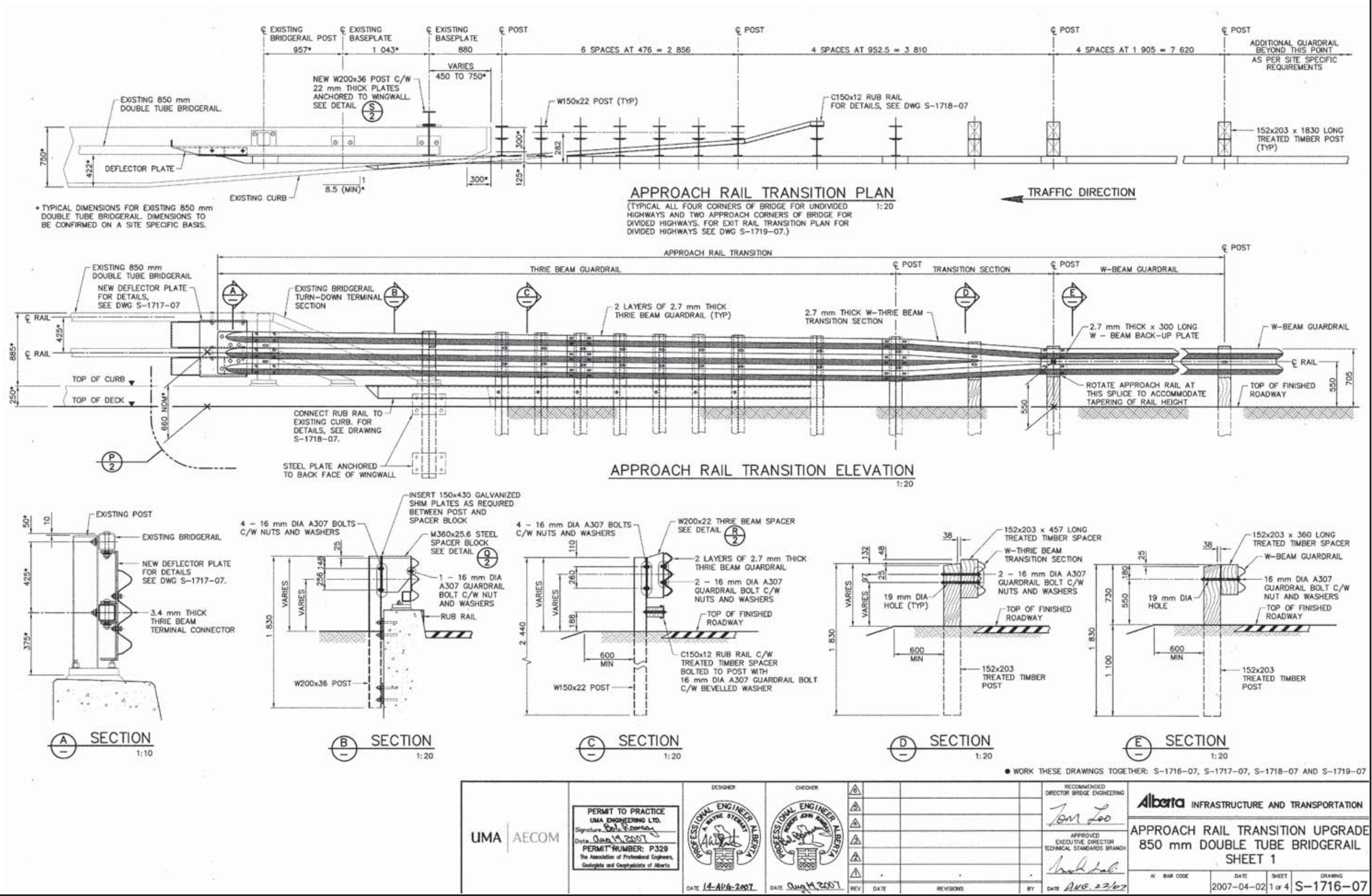
Alberta INFRASTRUCTURE AND TRANSPORTATION

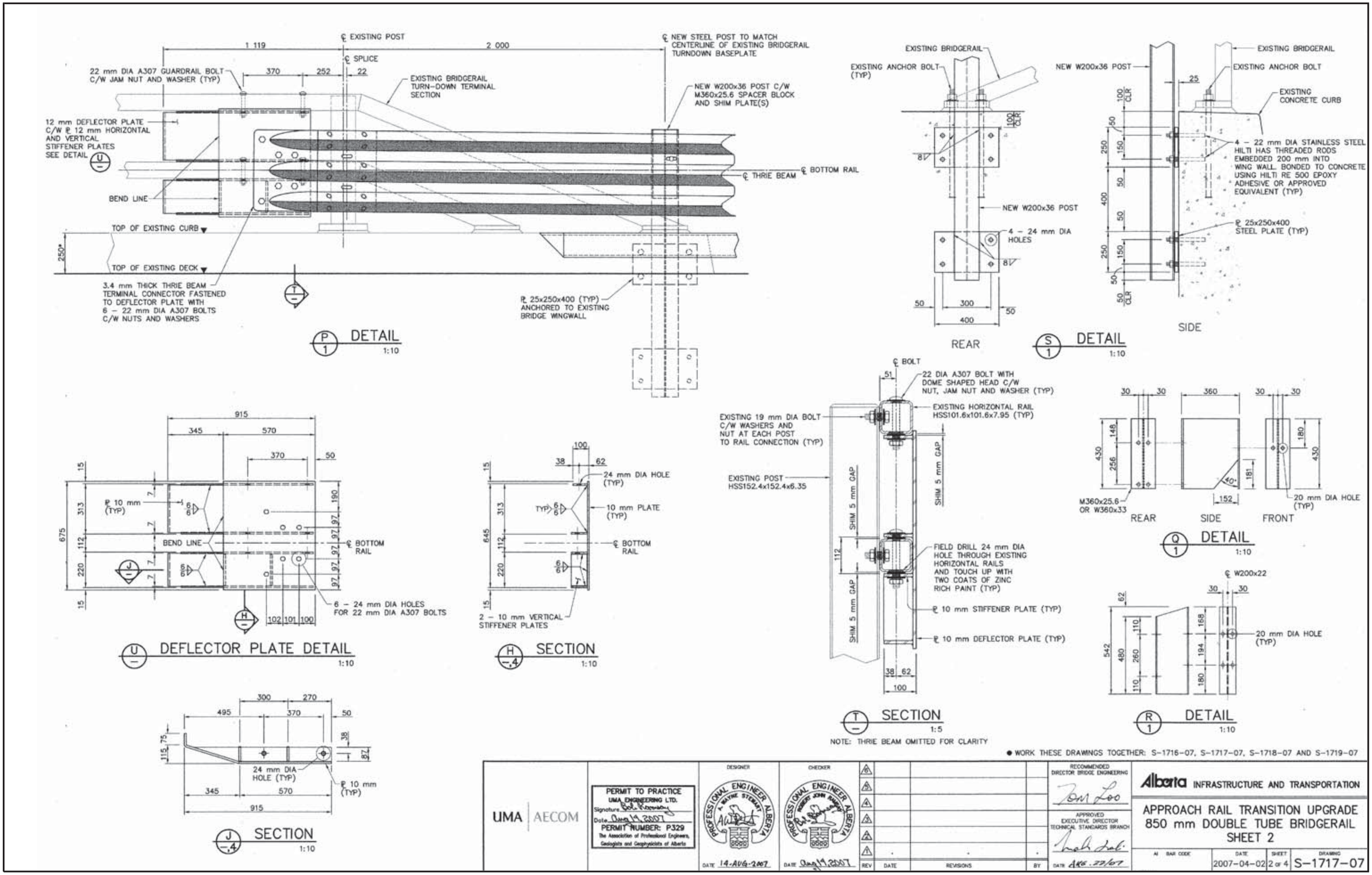
APPROACH RAIL TRANSITION UPGRADE
VERT. BAR / HORIZ. RAIL BRIDGERAIL
DIVIDED HIGHWAY – SHEET 1

AI BAR CODE	DATE	SHEET	DRAWING
	2007-04-02	1 of 3	S-1713-07

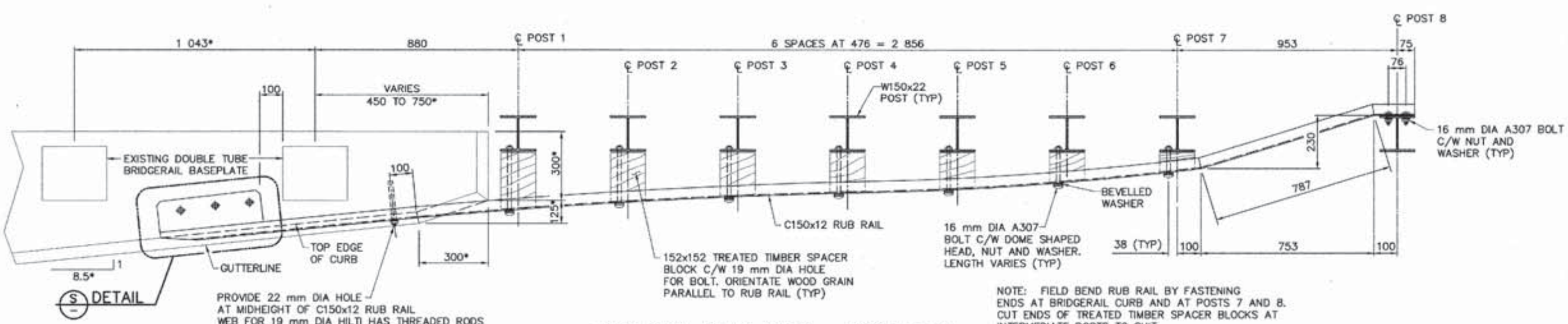

RUB RAIL PLAN VIEW 1:10
NOTE: THRIE BEAM AND THRIE BEAM SPACER BLOCK NOT SHOWN FOR CLARITY.
* TYPICAL DIMENSIONS FOR VERTICAL BAR OR HORIZONTAL RAIL TYPE BRIDGERAIL. DIMENSIONS TO BE CONFIRMED ON A SITE SPECIFIC BASIS.
** THE THRIE BEAM SPACER BLOCK (NOT SHOWN) MAY NEED TO BE TEMPORARILY REMOVED TO ALLOW FOR INSTALLATION OF THE RUB RAIL ANCHORS.
5 SPACES AT 476 = 2 380
152x152 TREATED TIMBER SPACER BLOCK C/W 19 mm DIA HOLE FOR BOLT. ORIENTATE WOOD GRAIN PARALLEL TO RUB RAIL (TYP)
16 mm DIA A307 BOLT WITH DOME SHAPED HEAD C/W NUT AND WASHER (TYP)
USE A BEVELLED WASHER FOR RUB RAILS CONNECTED TO BULLNOSE TYPE OR SQUARE TYPE CURB ENDS
CUT NOTCH OUT OF BOTH FLANGES AND BEND BACK. RECONNECT FLANGES WITH FULL PENETRATION WELD. (TYPx2)
MITRE ENDS AND RECONNECT WITH FULL PENETRATION WELD.
18 x 40 VERTICAL SLOTTED HOLE IN C150 (TYP)
16 mm DIA A307 BOLT C/W NUT AND WASHER (TYP)
E SECTION 1:5
TOP OF THREADED ROD FLUSH WITH TOP OF NUT
C150x12 RUB RAIL (COPE BOTTOM FLANGE FOR A MINIMAL LENGTH SUFFICIENT TO AVOID CONFLICT WITH FACE OF CURB)
3 - 19 mm DIA STAINLESS STEEL HILTI HAS THREADED RODS EMBEDDED 170 mm AND BONDED TO CONCRETE USING HILTI RE 500 EPOXY ADHESIVE OR APPROVED EQUIVALENT.
Q SPACER BLOCK DETAIL 1:10
*** SEE NOTE ON DWG S-1713-07. ADJUST DIMENSION AS REQUIRED.
S RUB RAIL TO CURB CONNECTION (TYPICAL) 1:5
F SECTION 1:10
G SECTION 1:10
H SECTION 1:10
CORE 25 mm DIA HOLE THROUGH CONCRETE (TYP)
6 - 22 mm DIA A307 BOLTS C/W NUTS AND ℘ 10x100x100 PLATE WASHERS (LENGTH TO BE SITE SPECIFIC)
6 - 24 mm DIA HOLES
2 - 19 mm DIA HOLES
25 mm CHAMFER TYPICAL
FOR BULLNOSE CURB END
FOR SQUARE CURB END
FOR TAPERED CURB END
RUB RAIL NOT REQUIRED IF THIS DIMENSION EXCEEDS 200 mm
RUB RAIL TO CURB CONNECTION PLAN 1:25
NOTE: SEE RUB RAIL PLAN VIEW FOR GEOMETRY.
● WORK THESE DRAWINGS TOGETHER: S-1713-07, S-1714-07 AND S-1715-07
UMA | AECOM
PERMIT TO PRACTICE UMA ENGINEERING LTD. PERMIT NUMBER: P329
Alberta INFRASTRUCTURE AND TRANSPORTATION
APPROACH RAIL TRANSITION UPGRADE
VERT. BAR / HORIZ. RAIL BRIDGERAIL
DIVIDED HIGHWAY - SHEET 2
DATE 2007-04-02 SHEET 2 of 3 DRAWING S-1714-07


EXIT RAIL TRANSITION PLAN
(TYPICAL AT TWO EXIT CORNERS OF BRIDGE) 1:20
ADDITIONAL GUARDRAIL BEYOND THIS POINT AS PER SITE SPECIFIC REQUIREMENTS
℄ POST
3 SPACES AT 1 905 = 5 715
1 688
END OF PARAPET
152x203 x 360 LONG TREATED TIMBER SPACER
152x203 x 1830 LONG TREATED TIMBER POST (TYP)
EXISTING CONCRETE PARAPET
EXISTING VERTICAL BAR OR HORIZONTAL RAIL TYPE BRIDGERAIL
EXISTING CURB
TRAFFIC DIRECTION
EXIT RAIL TRANSITION ELEVATION
1:20
EXIT RAIL TRANSITION
794
EXIT RAIL NOT REQUIRED ON DIVIDED HIGHWAYS PROVIDED THERE ARE NO HAZARDS DOWNSTREAM OF THE BRIDGE THAT WOULD WARRANT A BARRIER. TYPES OF HAZARDS THAT MAY WARRANT A BARRIER INCLUDE STEEP SIDE SLOPES AND FIXED OBJECTS WITHIN THE CLEAR ZONE.
2.7 mm THICK W-BEAM GUARDRAIL (TYP)
℄ RAIL
705
550
TOP OF FINISHED ROADWAY
TOP OF CURB
TOP OF DECK
SECTION A
1:15
38
25
180
550
730
1 830
1 100
152x203 x 360 LONG TREATED TIMBER SPACER
W-BEAM GUARDRAIL
16 mm DIA A307 GUARDRAIL BOLT
19 mm DIA HOLE
600 MIN
TOP OF FINISHED ROADWAY
COMPACT TO 95% SPMDD (TYP)
152x203 TREATED TIMBER POST
SECTION B
1:15
EXISTING CONCRETE PARAPET
CORE 25 mm DIA HOLES THROUGH CONCRETE (TYP)
2.7 mm THICK W-BEAM GUARDRAIL WITH 3.4 mm THICK TERMINAL CONNECTOR
SECURE W-BEAM TERMINAL CONNECTOR WITH 5 – 22 mm DIA A307 BOLTS C/W ℙ 10x80x80 PLATE WASHERS AND NUTS (LENGTH OF BOLTS TO BE SITE SPECIFIC)
APPROACH RAIL TRANSITION ANCHORAGE SEE DETAIL P
EXISTING CURB
TOP OF FINISHED ROADWAY
EXIT RAIL TRANSITION ANCHORAGE
(BACK FACE OF EXISTING CONCRETE PARAPET SHOWN) 1:15
TOP OF EXISTING CONCRETE PARAPET
102
101
541
90
90
END OF PARAPET
5 – ℙ 10x80x80 PLATE WASHER C/W 24 mm DIA HOLES
● WORK THESE DRAWINGS TOGETHER: S-1713-07, S-1714-07 AND S-1715-07
UMA | AECOM
PERMIT TO PRACTICE
UMA ENGINEERING LTD.
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
DESIGNER
CHECKER
DATE 14-AUG-2007
REV DATE REVISIONS BY
RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
DATE AUG. 22/07
Alberta INFRASTRUCTURE AND TRANSPORTATION
APPROACH RAIL TRANSITION UPGRADE
VERT. BAR / HORIZ. RAIL BRIDGERAIL
DIVIDED HIGHWAY – SHEET 3
DATE 2007-04-02
SHEET 3 OF 3
DRAWING S-1715-07


APPROACH RAIL TRANSITION PLAN 1:20
(TYPICAL ALL FOUR CORNERS OF BRIDGE FOR UNDIVIDED HIGHWAYS AND TWO APPROACH CORNERS OF BRIDGE FOR DIVIDED HIGHWAYS. FOR EXIT RAIL TRANSITION PLAN FOR DIVIDED HIGHWAYS SEE DWG S-1719-07.)
TRAFFIC DIRECTION
* TYPICAL DIMENSIONS FOR EXISTING 850 mm DOUBLE TUBE BRIDGERAIL. DIMENSIONS TO BE CONFIRMED ON A SITE SPECIFIC BASIS.
EXISTING 850 mm DOUBLE TUBE BRIDGERAIL.
DEFLECTOR PLATE
EXISTING CURB
NEW W200x36 POST C/W 22 mm THICK PLATES ANCHORED TO WINGWALL. SEE DETAIL S/2
W150x22 POST (TYP)
C150x12 RUB RAIL FOR DETAILS, SEE DWG S-1718-07
152x203 x 1830 LONG TREATED TIMBER POST (TYP)
ADDITIONAL GUARDRAIL BEYOND THIS POINT AS PER SITE SPECIFIC REQUIREMENTS
6 SPACES AT 476 = 2 856
4 SPACES AT 952.5 = 3 810
4 SPACES AT 1 905 = 7 620
APPROACH RAIL TRANSITION ELEVATION 1:20
APPROACH RAIL TRANSITION
THRIE BEAM GUARDRAIL
TRANSITION SECTION
W-BEAM GUARDRAIL
EXISTING 850 mm DOUBLE TUBE BRIDGERAIL
NEW DEFLECTOR PLATE FOR DETAILS, SEE DWG S-1717-07
EXISTING BRIDGERAIL TURN-DOWN TERMINAL SECTION
2 LAYERS OF 2.7 mm THICK THRIE BEAM GUARDRAIL (TYP)
2.7 mm THICK W-THRIE BEAM TRANSITION SECTION
2.7 mm THICK x 300 LONG W - BEAM BACK-UP PLATE
ROTATE APPROACH RAIL AT THIS SPLICE TO ACCOMMODATE TAPERING OF RAIL HEIGHT
TOP OF FINISHED ROADWAY
TOP OF CURB
TOP OF DECK
CONNECT RUB RAIL TO EXISTING CURB. FOR DETAILS, SEE DRAWING S-1718-07.
STEEL PLATE ANCHORED TO BACK FACE OF WINGWALL
SECTION A 1:10
EXISTING POST
EXISTING BRIDGERAIL
NEW DEFLECTOR PLATE FOR DETAILS SEE DWG S-1717-07.
3.4 mm THICK THRIE BEAM TERMINAL CONNECTOR
SECTION B 1:20
4 - 16 mm DIA A307 BOLTS C/W NUTS AND WASHERS
INSERT 150x430 GALVANIZED SHIM PLATES AS REQUIRED BETWEEN POST AND SPACER BLOCK
M360x25.6 STEEL SPACER BLOCK SEE DETAIL Q/2
1 - 16 mm DIA A307 GUARDRAIL BOLT C/W NUT AND WASHERS
RUB RAIL
W200x36 POST
SECTION C 1:20
4 - 16 mm DIA A307 BOLTS C/W NUTS AND WASHERS
W200x22 THRIE BEAM SPACER SEE DETAIL R/2
2 LAYERS OF 2.7 mm THICK THRIE BEAM GUARDRAIL
2 - 16 mm DIA A307 GUARDRAIL BOLT C/W NUTS AND WASHERS
C150x12 RUB RAIL C/W TREATED TIMBER SPACER BOLTED TO POST WITH 16 mm DIA A307 GUARDRAIL BOLT C/W BEVELLED WASHER
W150x22 POST
SECTION D 1:20
152x203 x 457 LONG TREATED TIMBER SPACER
W-THRIE BEAM TRANSITION SECTION
2 - 16 mm DIA A307 GUARDRAIL BOLT C/W NUTS AND WASHERS
19 mm DIA HOLE (TYP)
152x203 TREATED TIMBER POST
SECTION E 1:20
152x203 x 360 LONG TREATED TIMBER SPACER
W-BEAM GUARDRAIL
16 mm DIA A307 GUARDRAIL BOLT C/W NUT AND WASHERS
19 mm DIA HOLE
152x203 TREATED TIMBER POST
● WORK THESE DRAWINGS TOGETHER: S-1716-07, S-1717-07, S-1718-07 AND S-1719-07
UMA | AECOM
PERMIT TO PRACTICE UMA ENGINEERING LTD.
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
DESIGNER
CHECKER
DATE 14-AUG-2007
Alberta INFRASTRUCTURE AND TRANSPORTATION
RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
DATE AUG. 23/07
APPROACH RAIL TRANSITION UPGRADE
850 mm DOUBLE TUBE BRIDGERAIL
SHEET 1
2007-04-02
1 of 4
S-1716-07



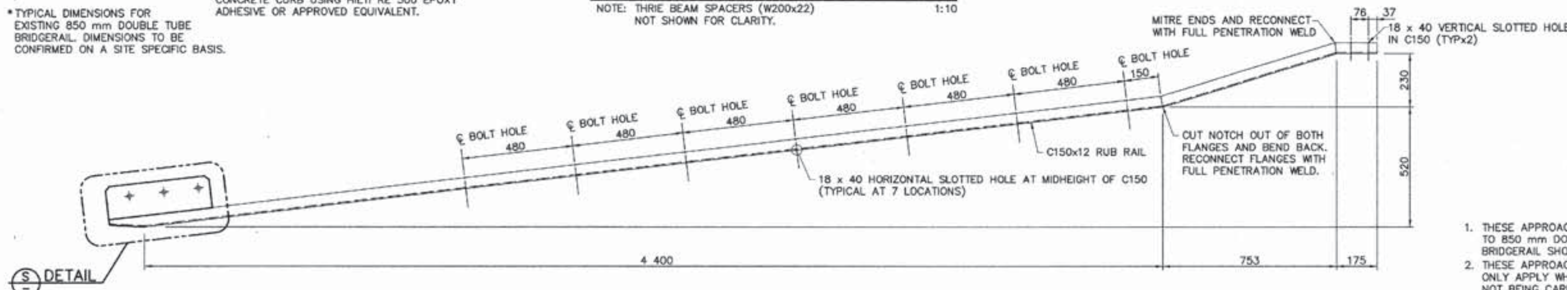
℄ EXISTING POST
℄ SPLICE
℄ NEW STEEL POST TO MATCH CENTERLINE OF EXISTING BRIDGERAIL TURNDOWN BASEPLATE
22 mm DIA A307 GUARDRAIL BOLT C/W JAM NUT AND WASHER (TYP)
EXISTING BRIDGERAIL TURN-DOWN TERMINAL SECTION
NEW W200x36 POST C/W M360x25.6 SPACER BLOCK AND SHIM PLATE(S)
12 mm DEFLECTOR PLATE C/W ℙ 12 mm HORIZONTAL AND VERTICAL STIFFENER PLATES SEE DETAIL
BEND LINE
℄ THRIE BEAM
℄ BOTTOM RAIL
TOP OF EXISTING CURB
TOP OF EXISTING DECK
3.4 mm THICK THRIE BEAM TERMINAL CONNECTOR FASTENED TO DEFLECTOR PLATE WITH 6 – 22 mm DIA A307 BOLTS C/W NUTS AND WASHERS
ℙ 25x250x400 (TYP) ANCHORED TO EXISTING BRIDGE WINGWALL
DETAIL P 1:10
EXISTING BRIDGERAIL
EXISTING ANCHOR BOLT (TYP)
NEW W200x36 POST
4 – 24 mm DIA HOLES
REAR
EXISTING ANCHOR BOLT
EXISTING CONCRETE CURB
4 – 22 mm DIA STAINLESS STEEL HILTI HAS THREADED RODS EMBEDDED 200 mm INTO WING WALL. BONDED TO CONCRETE USING HILTI RE 500 EPOXY ADHESIVE OR APPROVED EQUIVALENT (TYP)
ℙ 25x250x400 STEEL PLATE (TYP)
SIDE
DETAIL S 1:10
DEFLECTOR PLATE DETAIL U 1:10
ℙ 10 mm (TYP)
6 – 24 mm DIA HOLES FOR 22 mm DIA A307 BOLTS
24 mm DIA HOLE (TYP)
10 mm PLATE (TYP)
2 – 10 mm VERTICAL STIFFENER PLATES
SECTION H 1:10
24 mm DIA HOLE (TYP)
SECTION J 1:10
℄ BOLT
22 DIA A307 BOLT WITH DOME SHAPED HEAD C/W NUT, JAM NUT AND WASHER (TYP)
EXISTING HORIZONTAL RAIL HSS101.6x101.6x7.95 (TYP)
EXISTING 19 mm DIA BOLT C/W WASHERS AND NUT AT EACH POST TO RAIL CONNECTION (TYP)
EXISTING POST HSS152.4x152.4x6.35
SHIM 5 mm GAP
FIELD DRILL 24 mm DIA HOLE THROUGH EXISTING HORIZONTAL RAILS AND TOUCH UP WITH TWO COATS OF ZINC RICH PAINT (TYP)
ℙ 10 mm STIFFENER PLATE (TYP)
ℙ 10 mm DEFLECTOR PLATE (TYP)
SECTION T 1:5
NOTE: THRIE BEAM OMITTED FOR CLARITY
M360x25.6 OR W360x33
20 mm DIA HOLE (TYP)
REAR
SIDE
FRONT
DETAIL Q 1:10
℄ W200x22
DETAIL R 1:10
● WORK THESE DRAWINGS TOGETHER: S-1716-07, S-1717-07, S-1718-07 AND S-1719-07
UMA | AECOM
PERMIT TO PRACTICE
UMA ENGINEERING LTD.
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
PROFESSIONAL ENGINEER ALBERTA
DESIGNER
DATE 14-AUG-2007
CHECKER
REV DATE REVISIONS BY
RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
Alberta INFRASTRUCTURE AND TRANSPORTATION
APPROACH RAIL TRANSITION UPGRADE
850 mm DOUBLE TUBE BRIDGERAIL
SHEET 2
DATE 2007-04-02
SHEET 2 of 4
DRAWING S-1717-07



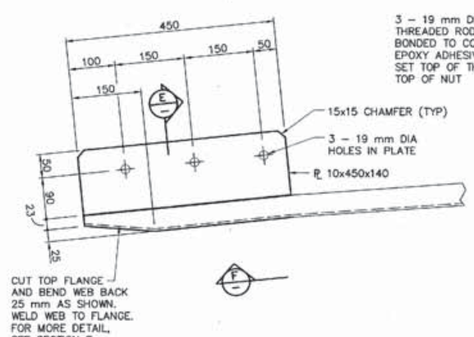
*TYPICAL DIMENSIONS FOR EXISTING 850 mm DOUBLE TUBE BRIDGERAIL. DIMENSIONS TO BE CONFIRMED ON A SITE SPECIFIC BASIS.

RUB RAIL PLAN VIEW – INSTALLED
1:10

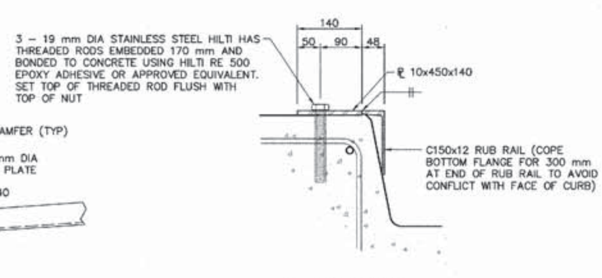
NOTE: THRIE BEAM SPACERS (W200x22) NOT SHOWN FOR CLARITY.



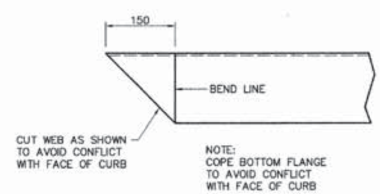
RUB RAIL PLAN VIEW – FABRICATED
1:10



S RUB RAIL/CURB CONNECTION
1:5



E SECTION
1:5



F SECTION
1:5

GENERAL NOTES

1. THESE APPROACH RAIL TRANSITION UPGRADE DRAWINGS APPLY TO 850 mm DOUBLE TUBE BRIDGERAILS SIMILAR TO THE BRIDGERAIL SHOWN ON DWG S-1400-95.
2. THESE APPROACH RAIL TRANSITION UPGRADE DRAWINGS ONLY APPLY WHEN UPGRADING OF THE BRIDGERAIL IS NOT BEING CARRIED OUT.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

FABRICATION

1. APPROACH RAIL TRANSITION SHALL CONFORM TO THE CURRENT REQUIREMENTS OF THE SPECIFICATIONS FOR BRIDGE CONSTRUCTION SECTION 14 – GUARDRAIL.
2. ALL PLATE STEEL AND STRUCTURAL SHAPES SHALL CONFORM TO CSA G40.21 GRADE 300W, OR ASTM A36.
3. ALL BOLTS SHALL CONFORM TO ASTM A325 UNLESS NOTED OTHERWISE.
4. ALL W-BEAM AND THRIE BEAM GUARDRAIL (INCLUDING THRIE BEAM TERMINAL CONNECTOR AND W-THRIE BEAM TRANSITION SECTION) SHALL HAVE A MINIMUM YIELD STRENGTH OF 345 MPa.
5. TIMBER POSTS AND SPACERS SHALL BE COAST DOUGLAS FIR OR PACIFIC COAST HEMLOCK CONFORMING TO THE STRESS GRADE "SELECT STRUCTURAL POSTS AND TIMBERS" (NLGA PARAGRAPH 131 a).
6. ALL WELDING SHALL CONFORM TO CURRENT AWS SPECIFICATION D1.5.
7. ALL NON-STAINLESS STEEL MATERIALS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH CSA G164 UNLESS NOTED OTHERWISE.

ERECTION

1. LINE AND ELEVATION OF BARRIER SHALL BE SET BY INSTRUMENT.
2. ALL POSTS SHALL BE VERTICAL.
3. ALL RAIL SECTIONS SHALL BE LAPPED IN THE DIRECTION OF TRAFFIC.
4. ALL GALVANIZED MATERIAL CUT OR DAMAGED IN THE FIELD SHALL BE TOUCHED UP WITH TWO COATS OF ZINC RICH PAINT.

● WORK THESE DRAWINGS TOGETHER: S-1716-07, S-1717-07, S-1718-07 AND S-1719-07

UMA | AECOM

PERMIT TO PRACTICE
UMA ENGINEERING LTD.
Signature
Date Aug 14, 2007
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

DESIGNER — DATE 14-AUG-2007
CHECKER — DATE Aug 14, 2007

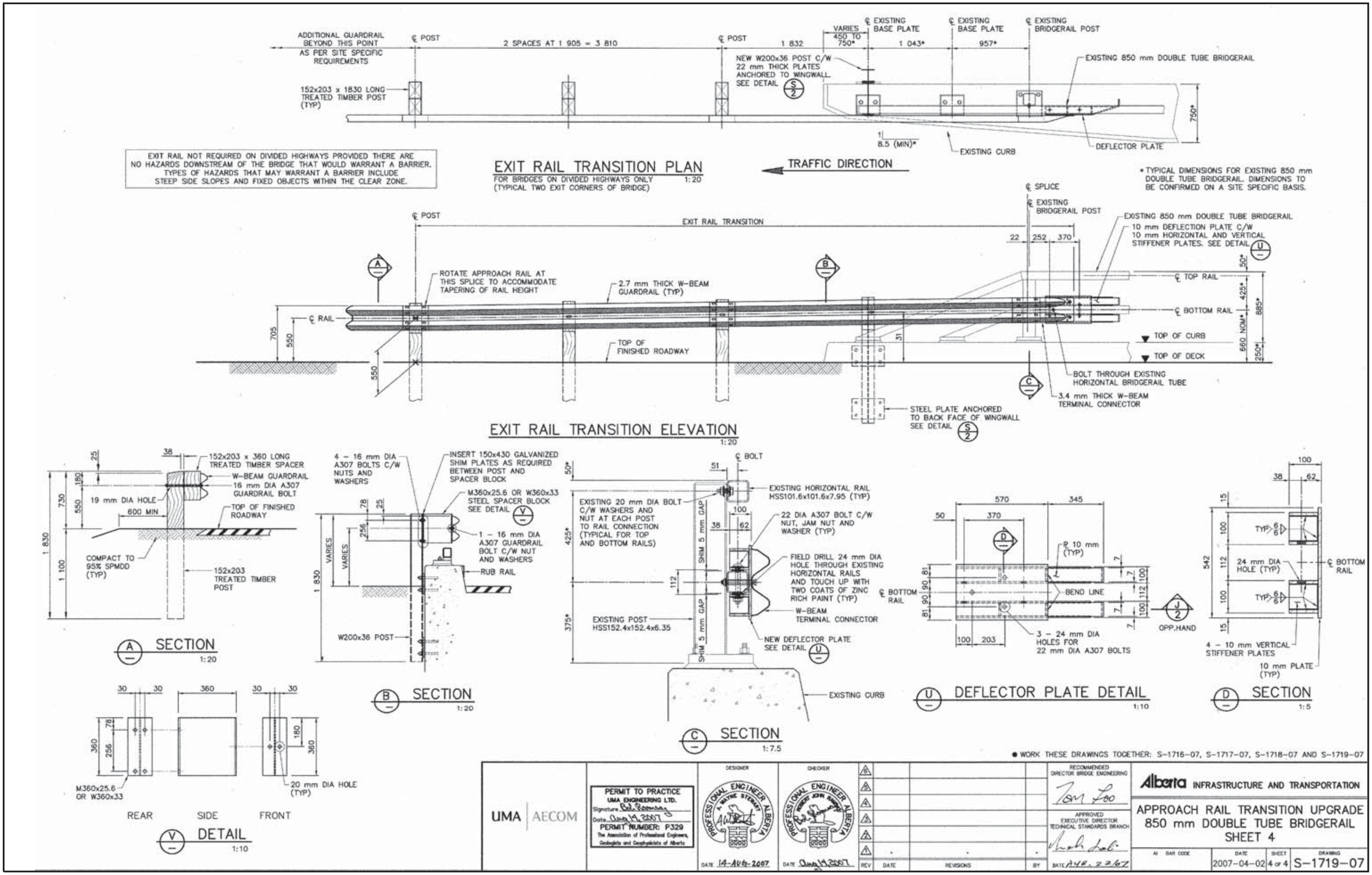
REV | DATE | REVISIONS | BY

RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
DATE AUG. 27/07

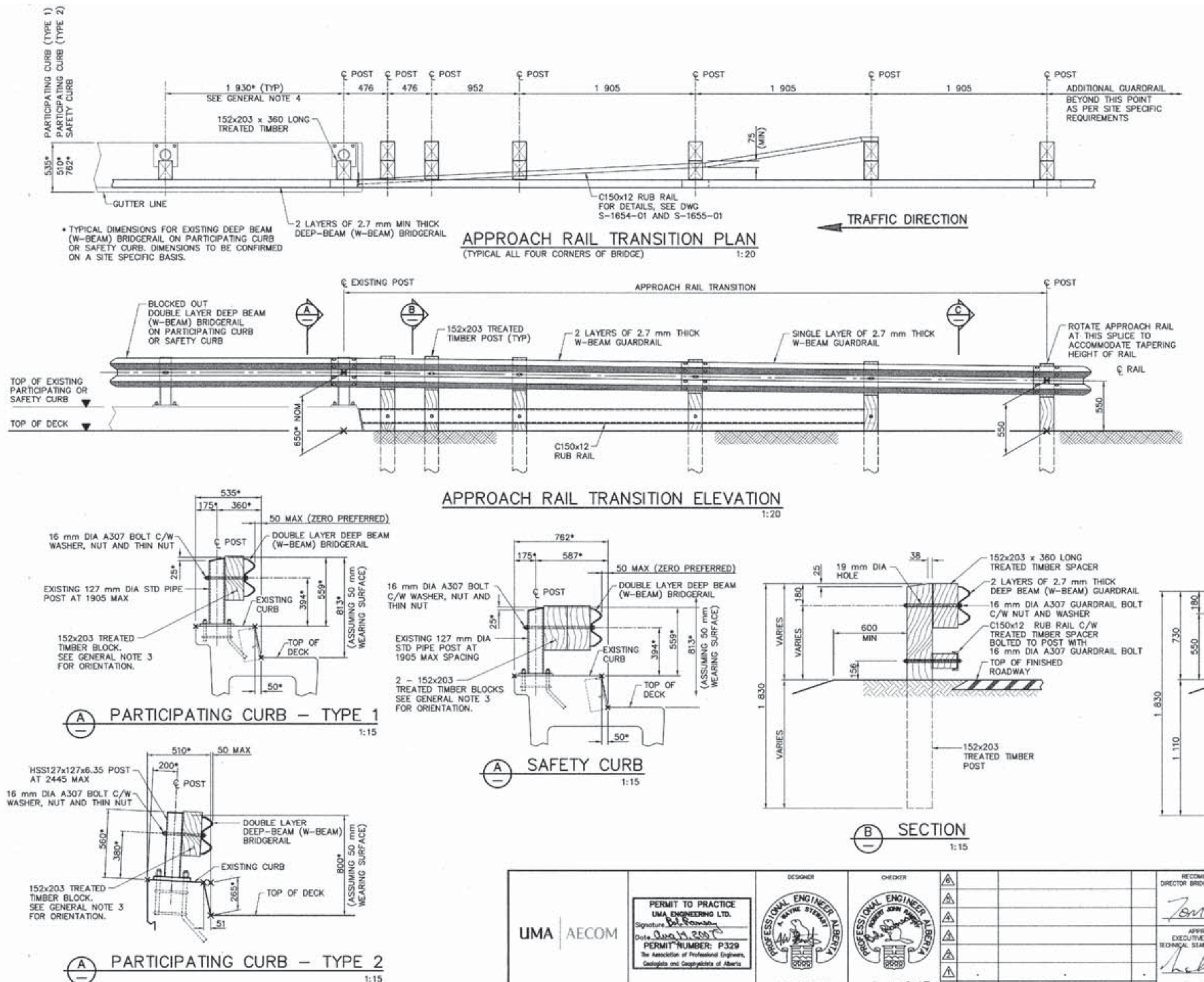
Alberta INFRASTRUCTURE AND TRANSPORTATION

APPROACH RAIL TRANSITION UPGRADE
850 mm DOUBLE TUBE BRIDGERAIL
SHEET 3

AI BAR CODE	DATE	SHEET	DRAWING
	2007-04-02	3 of 4	S-1718-07



ADDITIONAL GUARDRAIL BEYOND THIS POINT AS PER SITE SPECIFIC REQUIREMENTS
152x203 x 1830 LONG TREATED TIMBER POST (TYP)
2 SPACES AT 1 905 = 3 810
NEW W200x36 POST C/W 22 mm THICK PLATES ANCHORED TO WINGWALL. SEE DETAIL
EXISTING BASE PLATE
EXISTING BRIDGERAIL POST
EXISTING 850 mm DOUBLE TUBE BRIDGERAIL
EXISTING CURB
DEFLECTOR PLATE
EXIT RAIL NOT REQUIRED ON DIVIDED HIGHWAYS PROVIDED THERE ARE NO HAZARDS DOWNSTREAM OF THE BRIDGE THAT WOULD WARRANT A BARRIER. TYPES OF HAZARDS THAT MAY WARRANT A BARRIER INCLUDE STEEP SIDE SLOPES AND FIXED OBJECTS WITHIN THE CLEAR ZONE.
EXIT RAIL TRANSITION PLAN 1:20
FOR BRIDGES ON DIVIDED HIGHWAYS ONLY (TYPICAL TWO EXIT CORNERS OF BRIDGE)
TRAFFIC DIRECTION
* TYPICAL DIMENSIONS FOR EXISTING 850 mm DOUBLE TUBE BRIDGERAIL. DIMENSIONS TO BE CONFIRMED ON A SITE SPECIFIC BASIS.
EXIT RAIL TRANSITION
ROTATE APPROACH RAIL AT THIS SPLICE TO ACCOMMODATE TAPERING OF RAIL HEIGHT
2.7 mm THICK W-BEAM GUARDRAIL (TYP)
TOP OF FINISHED ROADWAY
10 mm DEFLECTION PLATE C/W 10 mm HORIZONTAL AND VERTICAL STIFFENER PLATES. SEE DETAIL
TOP RAIL
BOTTOM RAIL
TOP OF CURB
TOP OF DECK
BOLT THROUGH EXISTING HORIZONTAL BRIDGERAIL TUBE
3.4 mm THICK W-BEAM TERMINAL CONNECTOR
STEEL PLATE ANCHORED TO BACK FACE OF WINGWALL SEE DETAIL
EXIT RAIL TRANSITION ELEVATION 1:20
152x203 x 360 LONG TREATED TIMBER SPACER
W-BEAM GUARDRAIL
16 mm DIA A307 GUARDRAIL BOLT
19 mm DIA HOLE
TOP OF FINISHED ROADWAY
COMPACT TO 95% SPMDD (TYP)
152x203 TREATED TIMBER POST
SECTION A 1:20
4 - 16 mm DIA A307 BOLTS C/W NUTS AND WASHERS
INSERT 150x430 GALVANIZED SHIM PLATES AS REQUIRED BETWEEN POST AND SPACER BLOCK
M360x25.6 OR W360x33 STEEL SPACER BLOCK SEE DETAIL
1 - 16 mm DIA A307 GUARDRAIL BOLT C/W NUT AND WASHERS
RUB RAIL
W200x36 POST
SECTION B 1:20
EXISTING 20 mm DIA BOLT C/W WASHERS AND NUT AT EACH POST TO RAIL CONNECTION (TYPICAL FOR TOP AND BOTTOM RAILS)
EXISTING HORIZONTAL RAIL HSS101.6x101.6x7.95 (TYP)
22 DIA A307 BOLT C/W NUT, JAM NUT AND WASHER (TYP)
FIELD DRILL 24 mm DIA HOLE THROUGH EXISTING HORIZONTAL RAILS AND TOUCH UP WITH TWO COATS OF ZINC RICH PAINT (TYP)
W-BEAM TERMINAL CONNECTOR
NEW DEFLECTOR PLATE SEE DETAIL
EXISTING POST HSS152.4x152.4x6.35
EXISTING CURB
SECTION C 1:7.5
BEND LINE
3 - 24 mm DIA HOLES FOR 22 mm DIA A307 BOLTS
OPP.HAND
DEFLECTOR PLATE DETAIL U 1:10
24 mm DIA HOLE (TYP)
4 - 10 mm VERTICAL STIFFENER PLATES
10 mm PLATE (TYP)
SECTION D 1:5
M360x25.6 OR W360x33
20 mm DIA HOLE (TYP)
REAR
SIDE
FRONT
DETAIL V 1:10
• WORK THESE DRAWINGS TOGETHER: S-1716-07, S-1717-07, S-1718-07 AND S-1719-07
UMA AECOM
PERMIT TO PRACTICE UMA ENGINEERING LTD.
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
DESIGNER
DATE 14-AUG-2007
CHECKER
REV DATE REVISIONS BY
RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
Alberta INFRASTRUCTURE AND TRANSPORTATION
APPROACH RAIL TRANSITION UPGRADE
850 mm DOUBLE TUBE BRIDGERAIL
SHEET 4
DATE 2007-04-02
SHEET 4 of 4
DRAWING S-1719-07



GENERAL NOTES

1. THIS BRIDGERAIL AND APPROACH RAIL TRANSITION UPGRADE DRAWING APPLIES TO SINGLE AND DOUBLE LAYER DEEP BEAM (W-BEAM) BRIDGERAILS ON PARTICIPATING CURBS (TYPE 1) OR SAFETY CURBS, SUCH AS SHOWN ON DRAWING S-675-69. THIS DRAWING ALSO APPLIES TO DOUBLE LAYER DEEP BEAM (W-BEAM) BRIDGERAILS ON PARTICIPATING CURBS (TYPE 2), SUCH AS SHOWN ON DRAWING S-1402.
2. ADD SECOND LAYER OF 2.7 mm THICK W-BEAM GUARDRAIL TO BRIDGERAIL IF ONLY ONE LAYER OF DEEP BEAM (W-BEAM) GUARDRAIL EXISTS.
3. ORIENTATION OF NEW 152x203 TREATED TIMBER SPACER ON EXISTING BRIDGERAIL POST SHALL BE SET ON THE BASIS OF ALIGNING THE TRAFFIC FACE OF W-BEAM GUARDRAIL AS CLOSE AS POSSIBLE TO THE GUTTER LINE.
4. EXISTING BRIDGERAIL POST SPACING MAY VARY. POST SPACING SHALL BE VERIFIED IN THE FIELD.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

FABRICATION

1. APPROACH RAIL TRANSITION SHALL CONFORM TO THE CURRENT REQUIREMENTS OF THE SPECIFICATION FOR BRIDGE CONSTRUCTION SECTION 14 – GUARDRAIL.
2. ALL PLATE STEEL AND STRUCTURAL SHAPES SHALL CONFORM TO CSA G40.21 GRADE 300W OR ASTM A36.
3. ALL BOLTS SHALL CONFORM TO ASTM A307 UNLESS NOTED OTHERWISE.
4. ALL W-BEAM GUARDRAIL SHALL HAVE A MINIMUM YIELD STRENGTH OF 345 MPa.
5. TIMBER POSTS AND SPACERS SHALL BE COAST DOUGLAS FIR OR PACIFIC COAST HEMLOCK CONFORMING TO STRESS GRADE "SELECT STRUCTURAL POSTS AND TIMBERS" (NLGA PARAGRAPH 131a).
6. ALL WELDING SHALL CONFORM TO CURRENT AWS SPECIFICATION D1.5.
7. ALL NEW STEEL MATERIAL SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH CSA G164 UNLESS NOTED OTHERWISE.

ERECTION

1. LINE AND ELEVATION OF BARRIER SHALL BE SET BY INSTRUMENT.
2. ALL APPROACH RAIL POSTS SHALL BE VERTICAL.
3. ALL RAIL SECTIONS SHALL BE LAPPED IN THE DIRECTION OF TRAFFIC.
4. ALL GALVANIZED MATERIAL CUT OR DAMAGED IN THE FIELD SHALL BE TOUCHED UP WITH TWO COATS OF ZINC RICH PAINT.

UMA | AECOM

PERMIT TO PRACTICE
UMA ENGINEERING LTD.
Signature
Date Aug 14 2007
PERMIT NUMBER: P329
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

DESIGNER DATE 14-AUG-2007
CHECKER DATE Aug 14 2007

REV | DATE | REVISIONS | BY

RECOMMENDED DIRECTOR BRIDGE ENGINEERING
APPROVED EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH
DATE AUG 23/07

Alberta INFRASTRUCTURE AND TRANSPORTATION

DEEP BEAM (W-BEAM) BRIDGERAIL AND APPROACH RAIL TRANSITION UPGRADE DETAILS

DATE 2007-04-02 | SHEET 1 OF 1 | DRAWING S-1720-07