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New FSR bridge signage and the ‘Road Load Rating’ concept

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Outline

1. Speaker/ moderator introductions
2. Bridge capacity load limits
3. New bridge capacity signage
4. The “Road Load Capacity” concept

Bridge capacity load limits for resource road bridges are not well understood

- Bridge capacity signage historically and currently inadequate
- Implications of concentrated loads (i.e., short loads and tracked vehicles) not well understood
- Focus is on GVW – not understanding that this is based on a design vehicle configuration
- Resource roads are increasingly being used by mining, oil & gas, and clean energy projects
- Real concern for overloading of bridges
- A new methodology for posting of bridges is required

Very heavy loads used by non-forestry users of FSRs

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Concentrated loading

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New truck configurations

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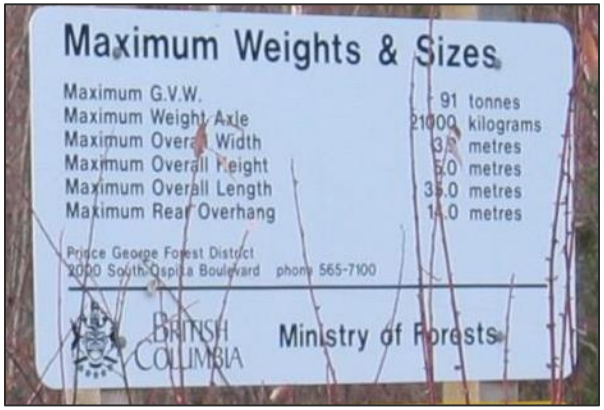
FSR capacity signs



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Determining the Safe Load Limit

- Analysis based on broad scale screening rather than designs of individual bridges.
- Force effects of actual trucks were compared against maximum design vehicle force effects to ensure that designs were sufficient.
- The live load factors for L-75, L-100 and L-150 bridge components were found to vary and some were inadequate.

Determining the Safe Load Limit

- To have a single live load factor for the L-series design vehicles, B&T recommended changes to GVW and weight distributions.
- B&T recommended that single, tandem, tridem axle group loads for the L-series vehicles be changed to 20%, 39%, and 43% of GVW instead of as portrayed in the current L-series design vehicles.
- The new design vehicle weights were used to determine safe load limits for GVW and axle loads, and concentrated loads.

Load Factors

- Analyses conducted with comparisons of force effects (shear and bending moment).
- Load factors (LL, DLA, DF) were the same for most design vehicles.
- S6-00 specifies LL = 1.70 for β = 3.75 however log truck traffic weights are better controlled than normal (PA) traffic.
- Analysis assumed NP traffic and lower LL values.
- Dead load was ignored in comparisons of vehicle force effects.

Summary of load factors

Design Vehicle	Design Live Load Factor	Dynamic Load Allowance	Distribution Factor
MOF L-Series	1.60	30%	0.69
BCL-625, LOH, HOH	1.50	30%	0.69
Axle groups (tridem, tandem, single)	1.50 to 1.60	30%	0.69
Short truck	1.60	30%	0.69
Tracked equipment on 2 girder forestry bridge	1.30	30%	0.69
Tracked equipment on slab or log stringers	1.30	24%	0.69

- Assumes annual permit (PA) traffic instead of normal (NP) traffic
- Lack of LL, DLA or DF data for tracked vehicles
- Tracked vehicles assumed to have little weight variation so LL = 1.30;
  20% lower DLA used to reflect slow travel, short spans, no axle groups

Load limits for B.C. forestry bridges

Design Vehicle	GVW Load Limit (tonnes) [a]	Single Axle Load Limit (tonnes) [b]	Tandem Axle Load Limit (tonnes) [b]	Tridem Axle Load Limit (tonnes) [b]	Short Truck Load Limit (tonnes) [a]	Tracked Equipment Load Limit (tonnes)[a c]
L-45	41	8.5	16.0	17.5	26	32
L-60	55	11.5	21.5	23.5	28	35
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LOH	82	19.5	37.0	40.5	46	57
L-100	91	19.0	36.0	39.5	47	57
HOH	129	31.0	58.0	n.a.	71	86
L-150	136	28.5	53.5	n.a.	70	85
L-165	150	31.5	59.0	n.a.	90	109

Notes:

a. *GVW load limits are limited to historic levels and rounded to the nearest tonne.*

b. *Axle group load limits are increased from historic levels and rounded to the nearest ½ tonne.*

c. *Tracked vehicle GVW load limits apply to concrete slab or gravel-log-stringer bridges. Design load limits for tracked vehicles on typical 2-girder forestry bridges can be increased from the limits shown by 19%.*

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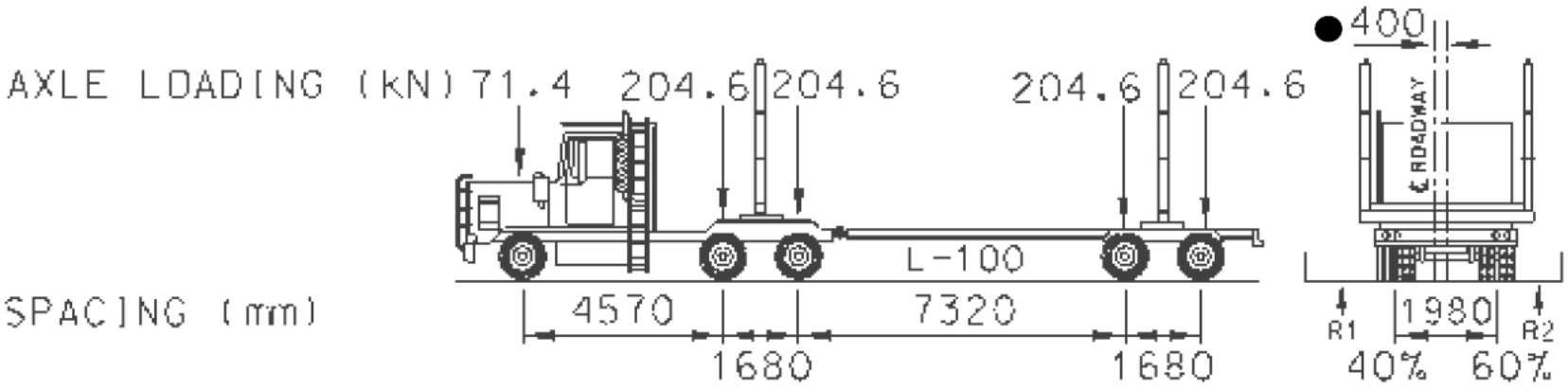
MOF L-Series: GVW and axle group load limits for L-100

- Assumed that GVW LL = 1.60 originally.
- Kept GVW load limits at historic 91 t level despite B&T recommending 6.7% higher values (i.e., 1.6/1.5).
- B&T found that single, tandem, tridem axle group loads for 5 axle trucks were 20%, 37%, and 40% of GVW instead of as portrayed in current L-series design vehicles.
- 6.7% higher axle group load limits were specified (e.g., tandem load = 36.0 t = 37% x 91 t x 1.067).

L-100 design vehicle



L-100 (OFF HIGHWAY) GVW 90,680 kg

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Load limits for B.C. forestry bridges

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LOH and HOH design vehicles

- LOH and HOH were derived from log truck data analysis (2000-03); FLNRO is reviewing them with more recent weigh scale data.
- Intent is to have light off-highway vehicle and heavy off-highway vehicle well matched to actual traffic.
- Going forward would phase out L-165, L-150, L-100, L-75 and only use BCL-625, HOH, LOH.

Load limits for B.C. forestry bridges

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Note: HOH GVW is 5% and 14% lighter than L-150 and L-165

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BCL-625 GVW and axle group load limits

- As specified in the Commercial Transport Act and consistent with MOTI specifications.
- Used on routes connected to highways.
- Although capacity may be understated for log hauling vehicles, it is well suited to highway traffic with more variable loading (NP type).

Load limits for B.C. forestry bridges

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Short truck load limit

- In lieu of studies, LL, DLA and DF same as log trucks.
- GVW load limit found with relative comparisons of shear and flexure to design bridge capacity.

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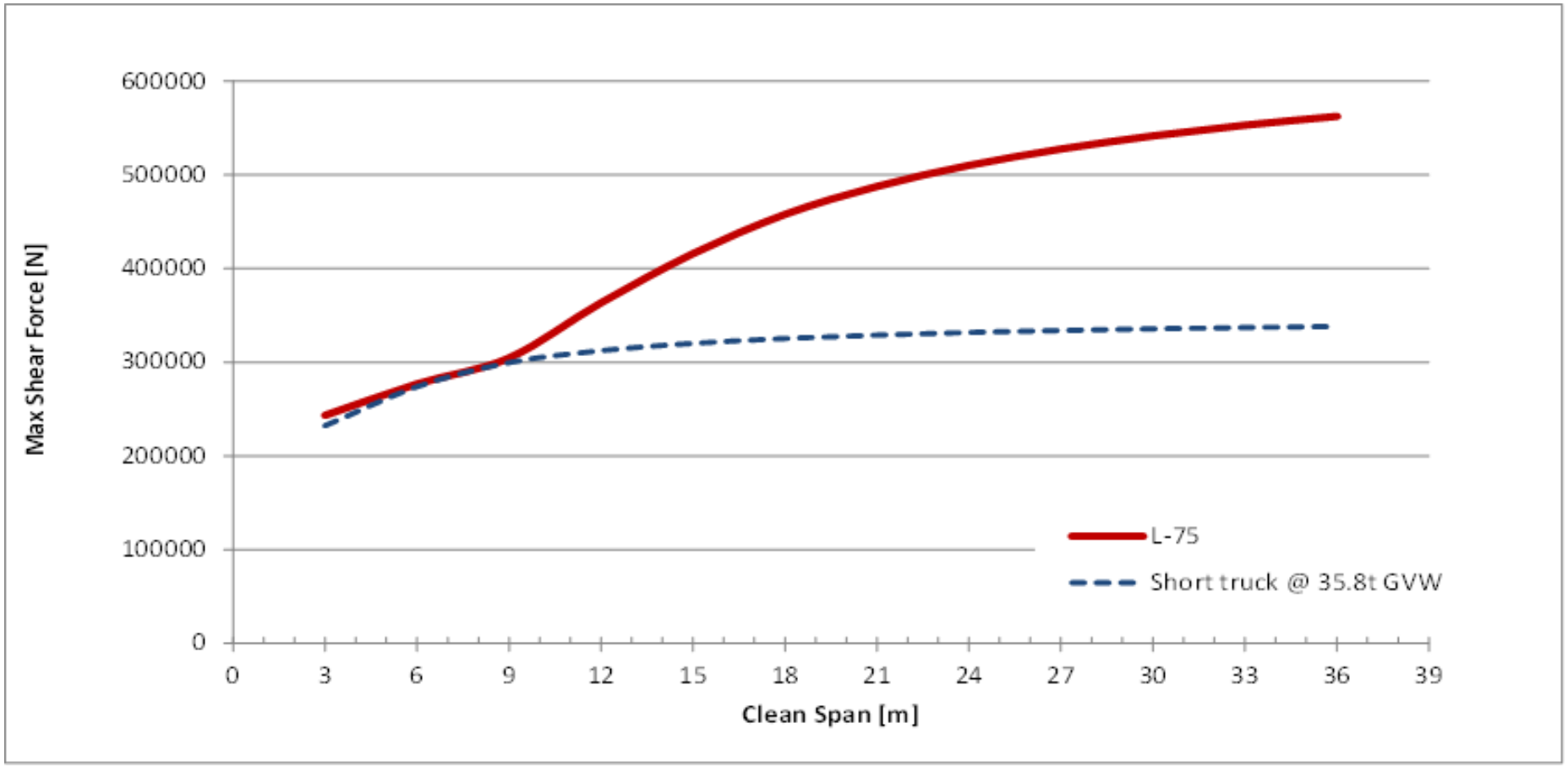
Short truck load limit.
Relative comparison of unfactored shear.



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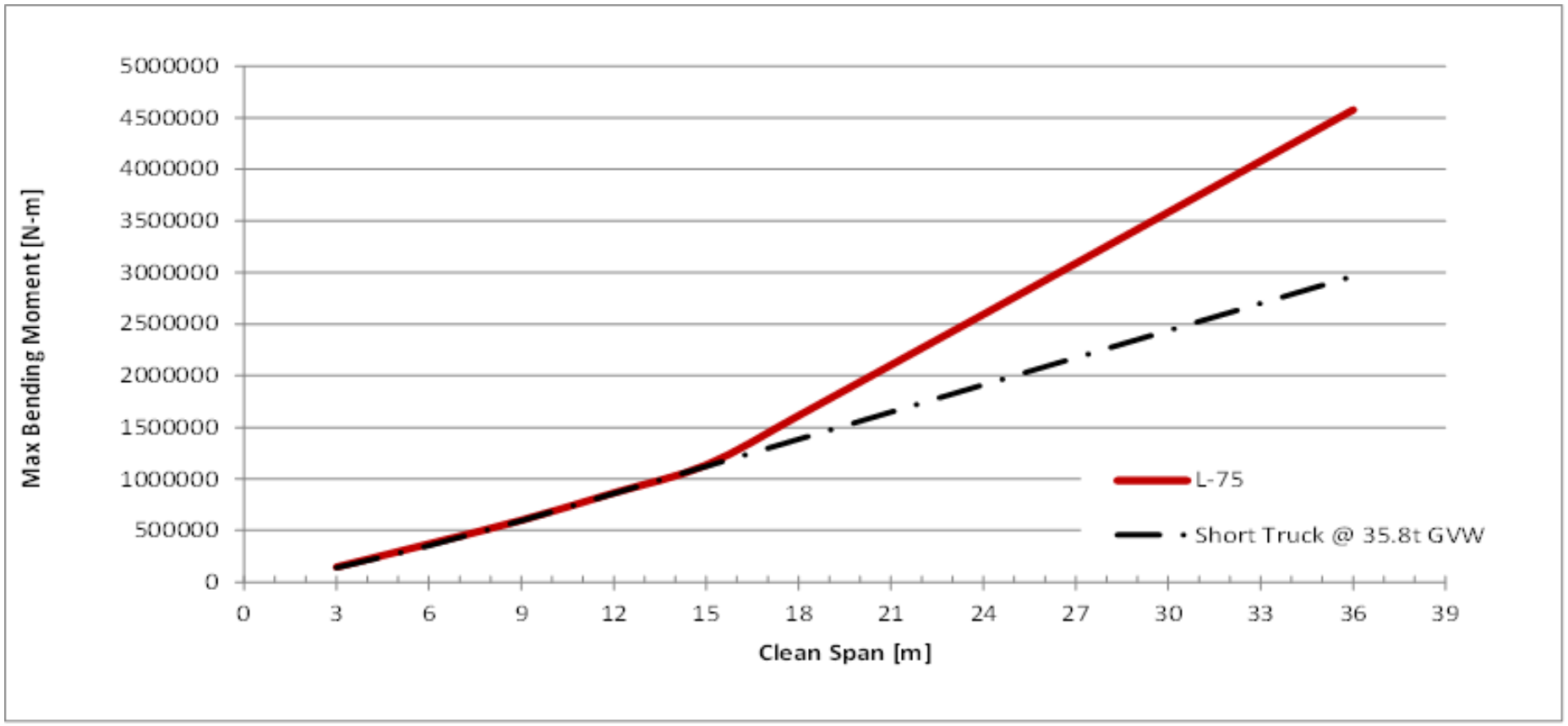
Short truck load limit.
Relative comparison of unfactored flexure.



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Tracked vehicle load limit

- Assumption: 4 m-long track contact length and uniform loading over this length.
- LL = 1.30 (no payload, predictable GVW)
- DLA = 0.30 (2 girder), 0.23 (slab, gravel-over)
- DF = 0.55 (track down centre, no turning)
- GVW load limit found with relative comparisons of shear and flexure to design bridge capacity.

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Note: ***Tracked vehicle GVW load limits apply to concrete slab or gravel-log-stringer bridges. Design load limits for tracked vehicles on typical 2-girder forestry bridges can be increased from the limits shown by 19%.***

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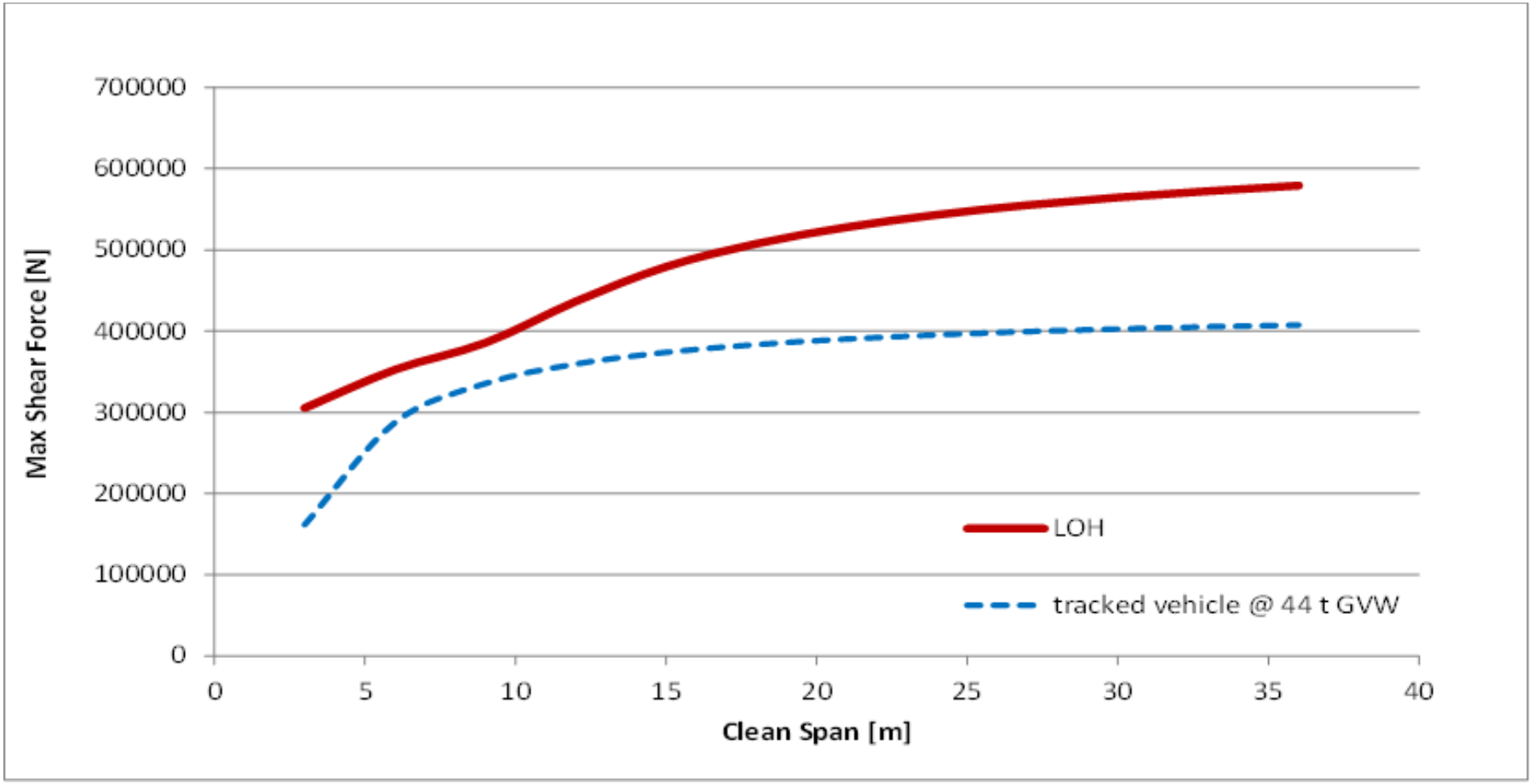
Tracked vehicle load limit.
Relative comparison of unfactored shear.



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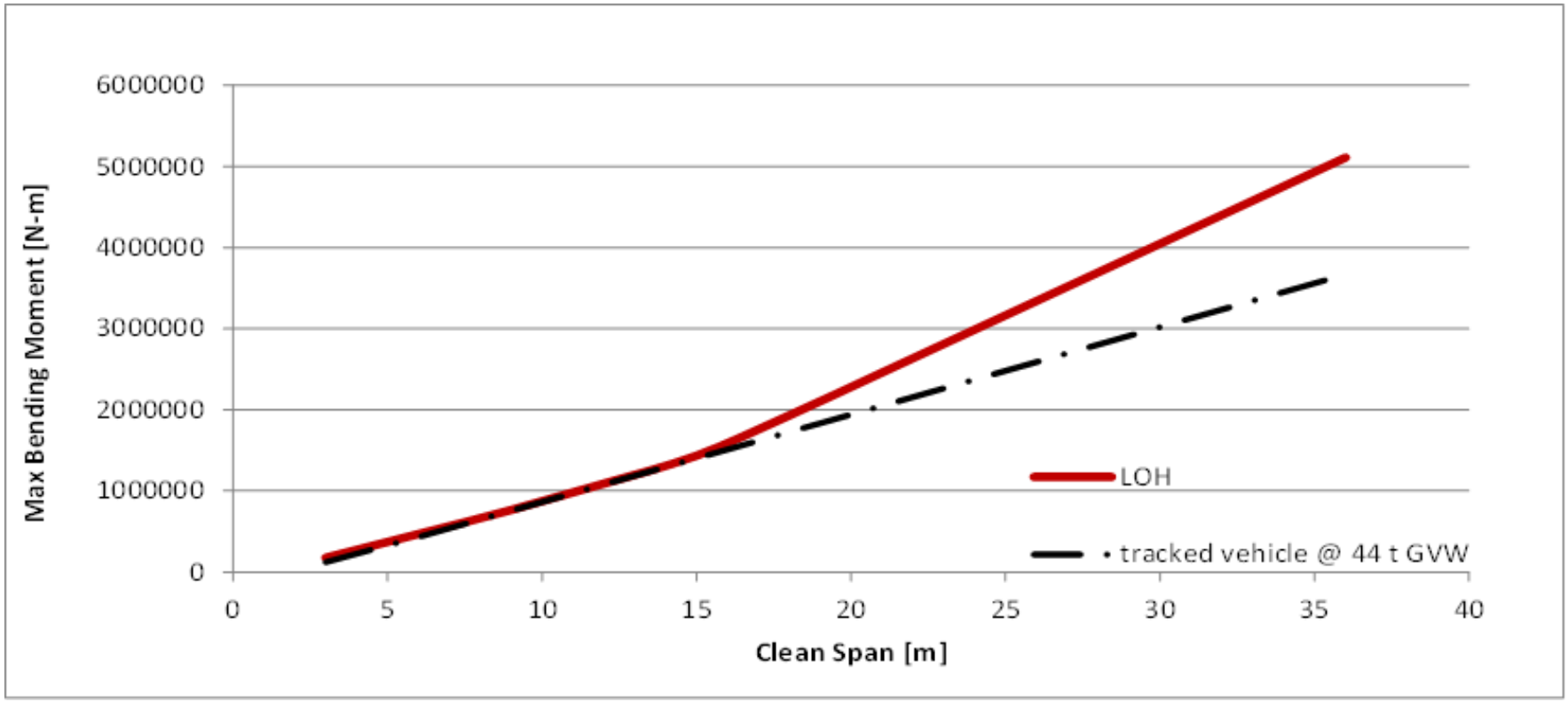
Tracked vehicle load limit.
Relative comparison of unfactored flexure.



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Tracked Vehicles

- Concern: L-165 not shown to be capable of supporting concentrated load of heaviest yarders (90 - 115 t).
- Option to design higher capacity new spans and up-rate existing spans by field rating per CHBDC Section 14.

Recap: Load limits for B.C. forestry bridges

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- MOF L-Series GVW remain at historic levels.
- Introducing new LOH and HOH bridge designs (load limits to be verified for current loadings).
- Sum of axle loads may exceed allowable GVW.
- Short truck and tracked equipment concentrate loading and need special treatment.
- Increase load limits for tracked equipment by 19% if for slab or gravel-over-log-stringer forestry bridges.

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Bridge capacity sign format

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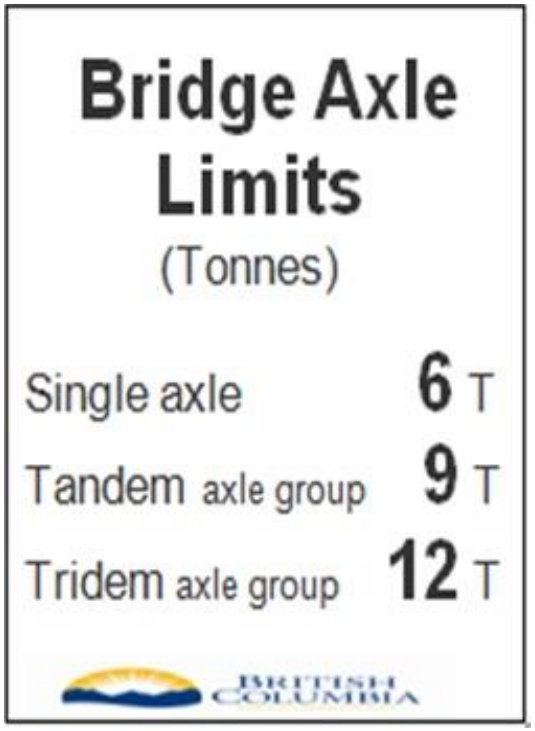
Bridge capacity sign format

- Original (existing) load limit signs are inadequate.
- L-series bridge design vehicles no longer look like most log trucks and other vehicles on FSRs.
- Need to allow road users to relate bridge ratings to their own vehicles.
- Need a way to address variable vehicle configurations.

Bridge capacity sign format



Some common formats

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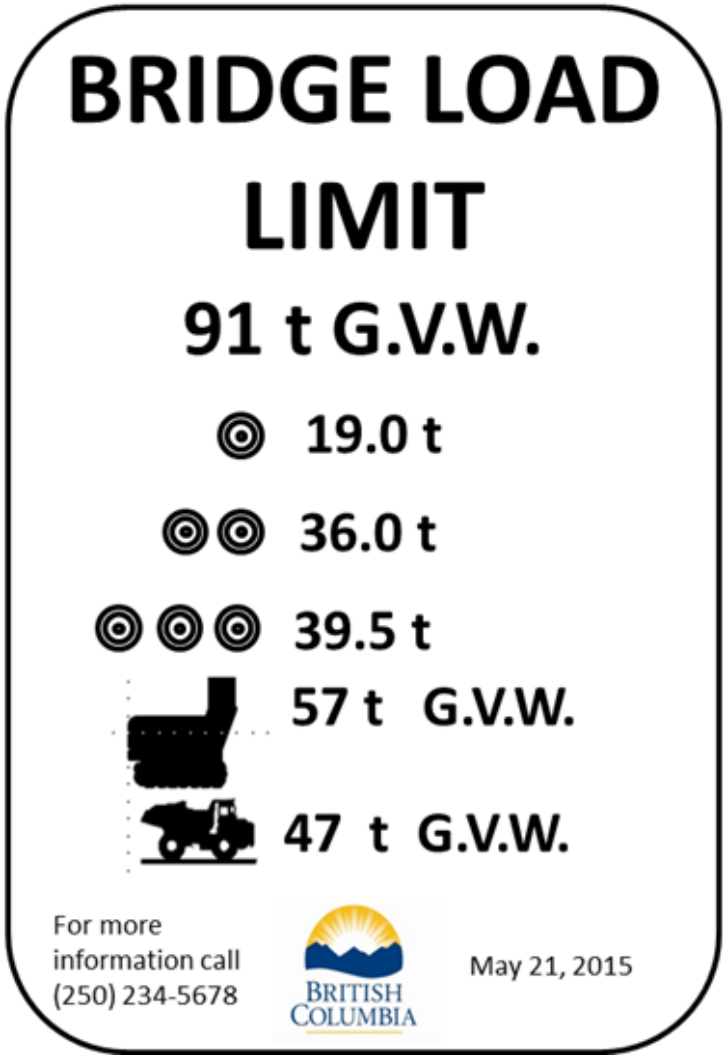
Full sign format



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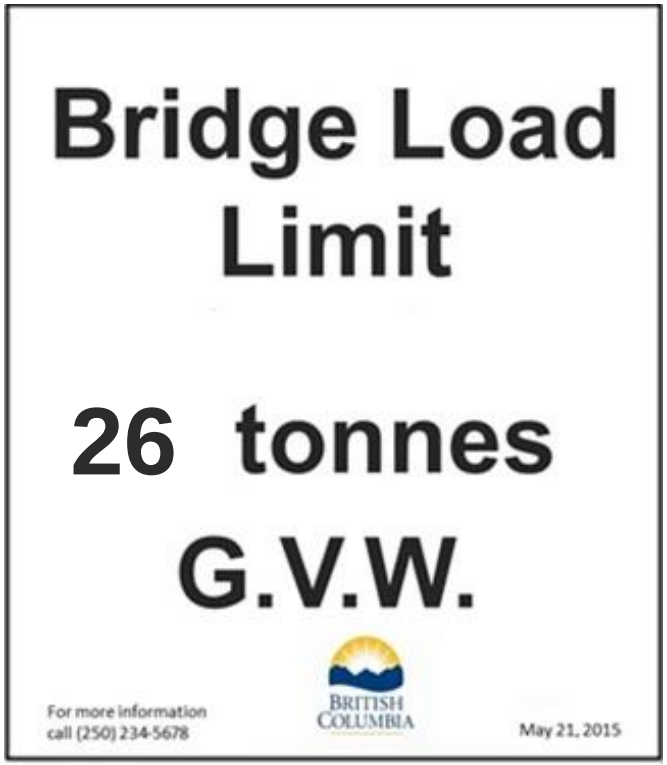
Sign format for L-45 bridges

- L-45 not sufficient for most truck GVW
- L-45 sufficient for some short trucks and tracked vehicles
- Load limit = minimum of short truck and tracked vehicle load limits (26 t).
- Up-rate with field rating?



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Sign format for down-rated bridges

- Existing sign formats for down-rated bridges

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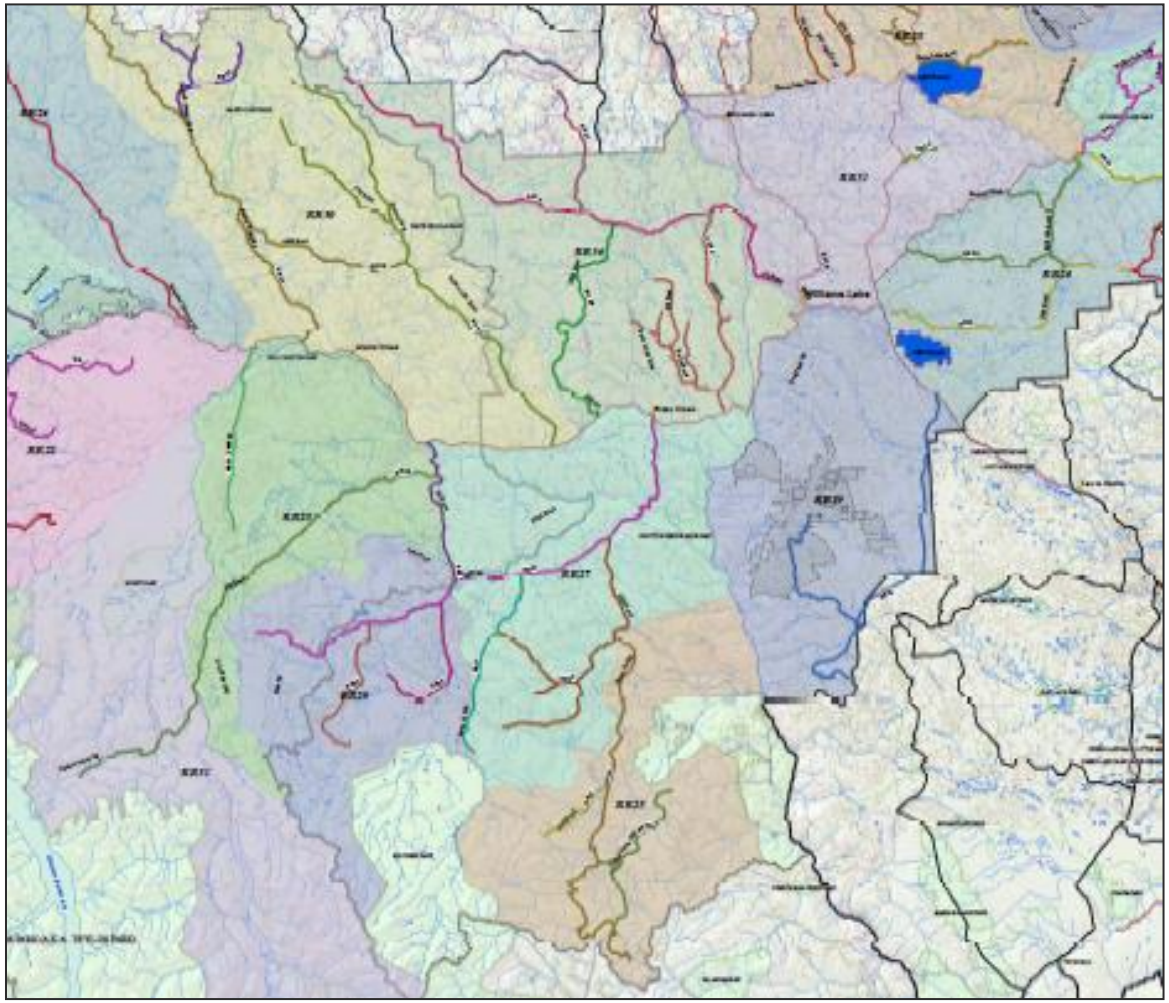
Road Load Rating concept



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Road Load Rating concept

- Not practicable or useful to post every bridge on a route with limits
- Road systems typically designed to specified design vehicle loading (e.g., L-100)
- One bridge rating per network. Posted bridge capacity signs are that of lowest capacity bridges on the network.
- Concept is same as used for Provincial highways where load limits are described in regulations only and bridges are good for all trucks. Only down-rated structures and heavy haul routes.

Road Load Rating concept - discussion

- Post exceptions beside network rating sign
  - Low capacity bridges and down-rated bridges.
  - May be confusing if many exceptions.
  - Also post exceptions at the bridge.

- Split network and post rating signs for each
  - *Posting applies from KM x to KM y of FSR*

Road Load Rating Concept – some of survey feedback

- Concept makes sense and is timely response to rapid industrial growth in north.
- Not sure that new signs will alleviate overloading problem – may only cost extra $.
- Capacity signs may change by season – confusing! May be better to make all bridges meet minimum capacity.
- Locate new sign somewhere safe to stop, near PoC, and where trucks can turn around.
- Some networks are inter-connected and will require signs at all entrances.
- Signs must clearly delineate applicable portion of network.

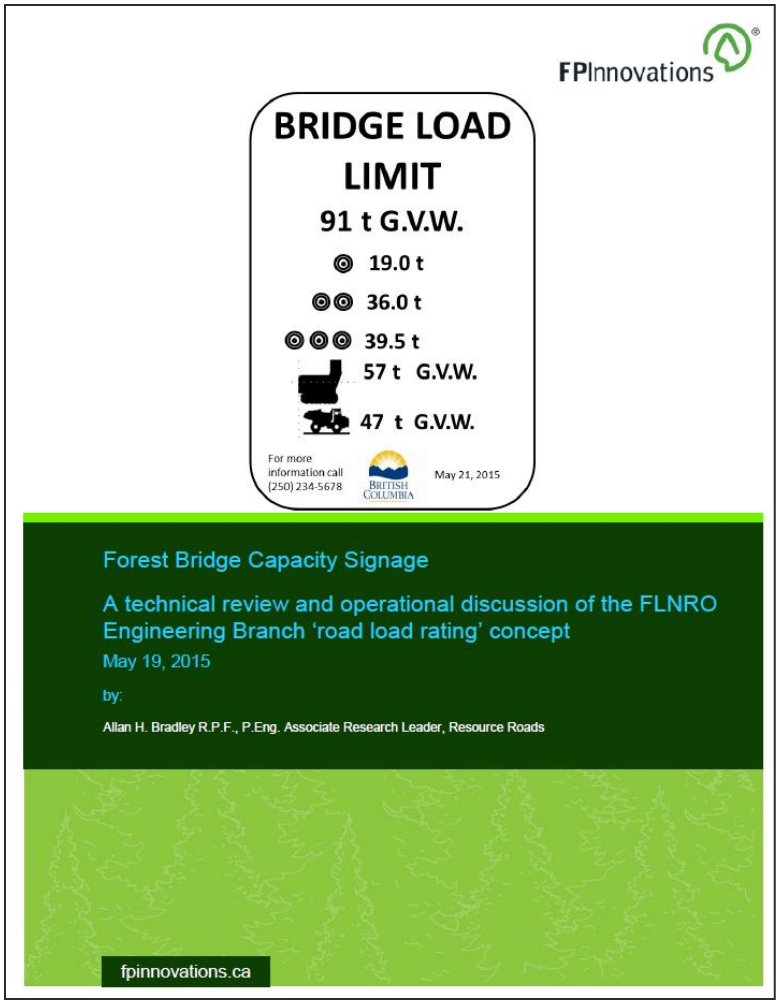
Road Use Permits

- Consistency with inclusion in road use permit documentation (Section 2 Conditions of Use).
- Better articulates loading limitations for vehicle types.
- Increases dissemination of safe vehicle weights including short truck and tracked equipment which aren't currently being captured or used.
- Could be used to detail what part of roads that road load rating applies to (if mix of FSR & RUP).
- Inform other road users thru cutting permits, construction contracts, BCTS bidding information, road signage, and local road safety committees.

Recap: Road Load Rating concept

- Opportunity to include inform road users about safe truck weights and what parts of road network that road load rating applies to.
- Inform other road users thru cutting permits, construction contracts, BCTS bidding information, road signage, and local road safety committees.

Questions and Discussion



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Thank you

For more information please contact:

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Brian Chow at (250) 953-4370 Brian.Chow@gov.bc.ca

Also see the road load rating project on the FLNRO Engineering Branch website
https://www.for.gov.bc.ca/hth/engineering/Bridges_And_Major_Culverts.htm

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