

## 6.4 Road Maintenance Inspections

Focus road maintenance inspections on the structural integrity of the road prism and clearing width, the effectiveness of drainage systems, and the condition of the road surface. Also consider road user safety, including signage and any values at risk. In addition, include in any road maintenance inspection a cursory examination of stream crossing structures to capture any visible signs of structural problems, abutment and pier scour, fish passage impediments or sediment deposition.

Before road maintenance inspections are carried out on FSRs, know and understand the level of road maintenance required on the road (e.g., wilderness road, industrial use, recreation access, community access) and the vehicle access objectives.

Prepare a road maintenance inspection schedule well in advance of the new fiscal year so that inspection costs and necessary staff resources can be budgeted for. A road maintenance inspection schedule includes the road names, the road use category (rural resident and recreation use; environmentally maintained (wilderness road); industrial use), the road risk rating, the scheduled times for planned road maintenance inspections, plus any pertinent comments that may impact schedules and practices.

- [Sample forest service road maintenance inspection schedule \(PDF\)](#)

Identify and prioritize required road maintenance works from field information documented during road maintenance inspections, and from information and incidents supplied by road users. From this information, prepare a road maintenance works plan to schedule and budget for required maintenance works to address the deficiencies.

Refer to the [Fish-stream Crossing Guidebook \(PDF, 4.3MB\)](#) when planning road maintenance inspections and maintenance works at fish-stream crossings.

### 6.4.1 Road Risk Ratings & Maintenance Inspection Priorities

Use the results of an engineering risk analysis to prepare road maintenance inspection schedules (see [Inspection Frequency Levels](#)) and priorities for road maintenance inspections. Risk is the chance of injury or loss, defined as a measure of the probability (likelihood) and the consequence of an adverse effect to health, property, the environment, or other things of value.

A road engineering risk analysis involves estimating levels of risk to known values at risk (such as road user safety, forest resources, and other values as may be appropriate) from potential hazardous and affecting events associated with the road. For example, a road on steep terrain rated as having a “high” risk of damage to water quality from a failure of the road drainage system would likely be assigned a higher inspection priority and scheduled for more frequent maintenance inspections than a road on gentle terrain that is rated as “low” risk.

Hazard, for assigning inspection priorities based on risk, is a source of potential harm or a situation, danger, or threat with a potential for causing an undesirable consequence. Identify and record hazards during maintenance inspections of roads and structures. For example, hazards within the road corridor or on slopes adjacent to the road corridor may include the following, among others:

- cut and fill slope failures and shoulder slumps;
- washouts;
- poor road running surface;
- brushed-in road corridor;
- an ineffective road drainage system;
- blocked ditches and culverts;
- on-going beaver activity at drainage structures;
- recurring fish passage issues on fish stream culverts;
- soil erosion and sediment transport;
- filled-in cross-ditches;
- erosion events related to weather;
- damaged guard rails or curbs on bridges;
- deterioration of structural elements;
- landslides; floods (freshet and heavy rain);
- hazardous spills.

Consequence is an effect on elements at risk. Elements at risk include humans, property, and forest resources [11 values identified in the *Forest and Range Practices Act (Sec. 149)*] and other values that may be at risk of damage or loss.

Conceptually, consequence is the change, loss, or damage to one or more element caused by a hazard event occurring and may involve consideration of an element’s worth.

“Risk rate” those roads undergoing road maintenance inspections, using a qualitative risk-analysis procedure.

There are many methods of risk analysis. Traditionally, risk (R) has been mathematically expressed as the product of two components: probability (likelihood) of occurrence (P) of a detrimental event, and consequence (C).

$$\text{Risk} = P \times C$$

Risk may also be expressed as the product of partial risk and vulnerability of the element at risk described in Land Management Handbook 56 (Sec. 3.6.1) (Wise et al. 2004):

$$\text{Risk} = P(\text{HA}) \times \text{vulnerability}, \text{ where}$$

**P(HA)** is partial risk and equal to the product of the probability (likelihood) of a hazard event occurring within a given period of time, and the probability that the hazard event will reach or affect the site occupied by a specific element of concern given that it occurs; and

**vulnerability** of an element (a component of consequence) is the estimated degree of loss to an element at risk, given that the hazard event occurs and reaches or affects the site.

A risk matrix is typically used to combine two risk components to determine qualitative risk ratings: very high (VH), high (H), moderate (M), low (L), and very low (VL).

An example of such a matrix is shown in Table 6-2. It is a five-row by three-column qualitative risk matrix that combines relative P(HA) ratings (VH, H, M, L, VL) and relative vulnerability ratings (H, M, L). However, a three-row (H, M, L) by three-column (H, M, L) matrix is often satisfactory for the purpose of assigning road maintenance inspection frequency levels and priorities (and maintenance works priorities).

Table 6-2 Example of a simple qualitative risk matrix for analyzing risk to visual resources

Risk = P(HA) x vulnerability, expressed as an annual likelihood of damage to visual resources in a scenic area from a road- associated landslide event <sup>a, c</sup>		Vulnerability ratings for visual resources in a scenic area (from <u>Table 6-8</u> )		
		High Damage	Moderate Damage	Low Damage
<b>P(HA) <sup>d</sup>: Annual likelihood of occurrence of a road- associated landslide and it reaching or affecting areas of timber on the slope below the road</b>	Very High	Very high	Very high	High

	High	Very high	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Very low
	Very Low	Low	Very low	Very low

Notes:

- a. The hazard or source of potential harm in this example is a road-associated landslide.
- b. The element at risk is visual resources in a scenic area (see [Table 6-8 in the appendix](#)).
- c. From the table, if P(HA) is high, and vulnerability is moderate damage, then the risk is high (expressed as an annual likelihood of damage to visual resources in a scenic area from a road-associated landslide).
- d. It is assumed that for P(HA):
  - Very high = the landslide event is expected to occur and affect the landscape in a scenic area (almost certain).
  - High = the landslide event will probably occur under adverse climatic conditions and affect the landscape in a scenic area (likely).
  - Moderate = the landslide event could occur under adverse climatic conditions and affect the landscape in a scenic area (possible).
  - Low = the landslide event might occur under very adverse climatic conditions and affect the landscape in a scenic area (unlikely).
  - Very low = the landslide event is inconceivable (rare), but it would affect the landscape in a scenic area if it occurred.

[Tables 6-4 to 6-9](#) provide examples of vulnerability tables for the following elements: forest road; domestic water supply; fish habitat; wildlife (non-fish) habitat and migration; visual resource in scenic area; and timber. The example vulnerability tables express, in terms of three relative qualitative ratings – H, M, and L – the degree of loss to an element at risk because of some hazard event occurring. Use these tables, in whole or in part, or in some modified form as required to reflect specific road and site conditions and elements at risk, to determine an element’s vulnerability for the purpose of assigning inspection priorities based on risk.

After the road has been “risk rated” – that is, as (H, M, or L) or (VH, H, M, L, or VL) – evaluate the risk as being acceptable or unacceptable and assign maintenance inspection priorities (and frequencies) accordingly. Generally, for a road that has a risk rating of “moderate” or “high” assign a higher priority for maintenance inspections.

For more information on risk management processes and different methods of risk analysis and risk matrices, refer to the following:

Basic information on qualitative risk analysis:

- B.C. Ministry of Forests. **Managing Risk Within a Statutory Framework**
- B.C. Ministry of Forests. Forest Road Engineering Guidebook (June 2002) (PDF, 7.61 MB)

Comprehensive technical references on qualitative and quantitative risk analysis:

- Wise, M.P., G.D. Moore, and D.F. VanDine (editors). 2004. Landslide risk case studies in forest development planning and operations. B.C. Min. For., Res. Br., Victoria, B.C. Land Manage. Handb. No. 56.
- References listed on the website of the Engineers and Geoscientists of B.C.

## 6.4.2 Road Inspection Frequencies

Expand All | Collapse All

**Industrial use FSRs**

**Non-industrial use “rural resident and recreation use FSRs”**

**Non-industrial use FSRs maintained by the ministry**

**Collision-related road and bridge inspections**

**Routine observations**

Table 6-3 Inspection Frequency Levels for FSRs Maintained by the Ministry

<b>Minimum Inspection Frequency Level for Non-industrial Use Environmentally Maintained FSRs (Wilderness Roads)</b>	<b>Road Risk Ratings</b>
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1 - At least once a year plus additional inspections after major storms and prior to annual freshets	A current road risk rating of <b>moderate, high, or very high</b>
2 - At least once every two years	A current road risk rating of <b>low or very low</b>
3 - At least once every three years	A current road risk rating of <b>low or very low AND</b> where the road is closed to public access by a man-made or naturally occurring barricade or blockage

Notes:

- For the purposes of Table 6-3, an inspection is one for which an Inspection Report is completed (see Road Maintenance Inspection Reports)
- Table 6-3 does not preclude the need for one-off inspections due to catastrophic events or due to new pertinent site information provided by FLNR and public users or other agencies.

### 6.4.3 Road Maintenance Inspection Reports

Road maintenance inspections cover key road components. Record in an inspection report any deficiencies observed. Where major problems are identified, take photographs to accompany the inspection reports. Assess and evaluate the following when a road maintenance inspection is carried out:

- user safety;
- structural integrity of the road prism and clearing width;
- drainage systems;
- potential for transport of sediment from the road prism;
- road and bridge surfaces;
- fish passage at stream crossings; and
- any upgrade requirements necessary for proposed industrial use.

Document all road maintenance inspections using a suitable road maintenance inspection report. Place a hard copy of the report on file for possible future review by the appropriate ministry manager or for review by others in the case of audits. The review of past reports can be helpful for identifying road segments or drainage structures that:

1. have recurrent problems and should receive a higher road risk rating, or
2. should receive more frequent inspections or be scheduled earlier for maintenance works.

Ensure that road maintenance inspection reports are reviewed and signed off by the appropriate Timber Operations and Pricing Division/BCTS staff prior to filing. Additionally, enter a record of the road maintenance inspection report into the appropriate computerized road management system.

Use the sample inspection report (or other equivalent report formats) to document maintenance inspections of roads and minor drainage structures.

- [Sample forest service road maintenance inspection report \(PDF\)](#)

Use the following documents along with the sample report:

- [Inspection codes for "problems noted" \(PDF\)](#)
- [Maintenance codes for "recommended maintenance works" \(PDF\)](#)

Include in the road maintenance inspection reports:

- the current and revised (if any) road risk rating;
- the date of the inspection (to establish a time frame for maintenance works, to have on hand for future reference, and to provide a better inspection history record);
- the name of the person doing the inspection (for accountability and for future reference);
- details about the weather conditions at the time of the inspection (to explain observed surface runoff conditions that have occurred with prolonged or intense rainfall events before or during culvert inspections);
- the road name and project number (to identify where the inspection took place);
- the purpose of the inspection (scheduled, post-storm event, user complaint, other);
- the location of the inspection by geographic coordinates or station (e.g., "km 0.0 through to km 6.35," to identify the exact location of any concerns);
- the locations of individual problems by geographic coordinates or station, and all relevant data for each issue;
- description of problems using Inspection Codes;
- good quality site photographs taken from a logical point of view or perspective;
- a recommended reasonable time frame for repairs to be completed, and a rationale for that time frame (e.g. maintenance work should be carried out before fall rains to reduce

soil erosion and sediment transport); and

- any further description of the works required should be placed in the comments section for each location.

As a result of the inspection, identify those works to be entered into either the current or the future maintenance works plan. When possible and commensurate with the priorities of Timber Operations and Pricing Division/BCTS, address deficiencies within an appropriate time frame.

Prepare a road maintenance works plan and prioritize maintenance works in accordance with the risks identified in the inspections. Retain the inspection reports on file as documented evidence that inspections have been carried out, and to serve as references for future maintenance projects. Reviews of past reports and records can assist forest road managers in identifying recurrent problems and identifying those road sections to be assigned a higher risk rating.