Silviculture Prescription Data Collection Field Handbook

Interpretive Guide for Data Collection, Site Stratification, and Sensitivity Evaluation for Silviculture Prescriptions

2000
SOIL HAZARD ASSESSMENT

The Operational Planning Regulation requires an assessment of soil disturbance hazards for areas under a silviculture prescription that will be harvested by methods other than cable or aerial. Filling out the soil hazard assessment section of the plot card for all other areas may still be advisable. For instance, the Mass Wasting Hazard section (for the Interior only), similar to item 46 (“Indicators of Potential Slope Instability”), may help to identify (“red flag”) problem slopes, which can be missed by terrain mapping. The Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook, referenced in the Operational Planning Regulation, contains the necessary assessment procedures. These procedures are summarized below for the soil hazard sections contained on the plot card (FS 39A).

After digging a representative soil pit, determine the rating for Soil Compaction, Soil Displacement, and Soil Erosion. Although not required by legislation, Forest Floor Displacement, and (in the Interior) Mass Wasting Hazards may be assessed at little, or no extra cost; these hazards are referred to in local guides for construction and rehabilitation of excavated and bladed trails (e.g., Curran 1999) and root rot treatments (e.g., Norris et al. 1998).

For all hazard assessments, the classes are: very high (VH); high (H); moderate (M); and low (L). Where variability in site conditions results in a range of values that span two hazard classes, the combination should be indicated (e.g., moderate–high).

The soil hazard assessments should be completed at the pit. This will ensure that ratings are reviewed and confined on site, and any important management considerations are contemplated while the surveyor is still in the field. To assist with the rating process, the Soil Hazard Assessment section of the plot card (FS 39A) is adjacent to the soil pit information already collected. For the information necessary to complete each hazard assessment, refer to the item number on the plot card.

Precipitation factors for biogeoclimatic subzones by forest region are needed for some of the hazard assessments (see Appendix 4). This information is also found in the Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook. More discussion of each hazard and the development of strategies to deal with them is contained in Curran (1999).

43. SOIL HAZARD ASSESSMENT
The Operational Planning Regulation requires that the SP must specify the hazards for soil compaction, soil erosion, and soil displacement for any area identified in a forest development plan that will be harvested by a method other than cable or aerial.
Compaction and Puddling Hazard: Determine the applicable moisture regime by referring to item 13. Soils with xeric to mesic moisture regimes, or subhygric with a forest floor H horizon (item 27) less than 20 cm thick, are rated separately from subhygric soils with a forest floor H horizon greater than 20 cm thick, or where the soil moisture regime is hygric or wetter. For the moisture regime selected, circle the dominant coarse fragment content (item 33) and the most sensitive texture (item 31) for the top 0–30 cm of mineral soil. When a pronounced textural change occurs (i.e., ≥ 5 cm) within the upper 30 cm (e.g., silty over sandy soil), use the more limiting soil texture. Circle the hazard rating.

“Clayey” refers to all textures with clay in the name (i.e., SC, SiCL, SCL, CL, SiC, and C). For the purposes of this assessment, fSL, “fine sandy loam” means that the soil contains 30% or more of fine or very fine sand, or more than 40% of fine and very fine sand combined. Fine sand is 0.25–0.10 mm in diameter, very fine sand is 0.10–0.05 mm in diameter; these generally represent the limits of visible particles.

Compaction is the increase in soil density that results from the rearrangement of soil particles in response to applied external forces. Puddling is the destruction of soil structure that results from working wet soil. Both lead to loss of macroporosity, reduced water infiltration, increased resistance to root penetration, and reduced aeration, which all potentially affect slope hydrology and soil productivity.

Soil Displacement Hazard: Circle the average slope percent (item 11). For gullied (item 19) or hummocky terrain (item 16), additional points are assigned only when these features are present. Referring to item 38 (unfavourable substrate), note the subsoil condition and depth. If more than one unfavourable substrate is present, choose the condition closest to the surface that results in the highest point value. Add the total points and circle the hazard rating.

Organic soils with 40 cm or more of wet, organic material are rated as “High Displacement Hazard.” Forest floors over bedrock or skeletal materials (e.g., Folisols) are rated as “Very High Displacement Hazard.”

Soil displacement is the mechanical dislocation of soil materials by equipment and by the movement of logs or trees. It involves excavation, scalping, exposure of underlying unfavourable materials, and burial of surface soils. This can result in nutrient redistribution, loss of available nutrients, and potential losses in soil productivity. Soil displacement can also affect slope hydrology by exposing or diverting seepage water and runoff.
Soil Erosion Hazard: Determine the precipitation factor for the BEC subzone by referring to Appendix 4. Circle the applicable site condition. Referring to the plot card items 11, 17, and 38, circle the appropriate description. Use the most limiting texture and coarse fragment combination in the top 15 cm of mineral soil (i.e., if two contrasting textures or coarse fragment contents occur at this depth, use the one with the highest point rating). Apply the same principle for the subsoil texture (16–60 cm depth). Add the total points and circle the hazard rating.

Gently sloping areas with long uniform slopes may rate a high soil erosion hazard; given the right combination of conditions, substantial erosion can occur on these sites.

Soil erosion is the wearing away of the surface soil by water and wind and includes splash, rill, and gully erosion. It causes both on-site effects (e.g., soil loss, nutrient loss, productivity loss) and off-site effects (e.g., lower water quality, sedimentation, habitat deterioration). Splash erosion occurs when raindrops transport soil particles. Rill erosion occurs when surface water moves into small depressions, gains depth and velocity, and transports soil particles. Gully erosion occurs when water movement increases in depth, volume, and velocity. Two predominant types of gullies occur.

- V-shaped – Form in soils that are either shallow or uniformly erodible with increasing depth.
- U-shaped – Form in less erodible soils that overlie more erodible soils (e.g., fine textured B horizon over a sandy C horizon), or form in dense or partially cemented soils (e.g., silty lacustrine, calcareous glaciofluvial deposits).

OPTIONAL HAZARDS

Forest Floor Displacement Hazard: This optional assessment helps both the surveyor and the prescriber recognize the relative importance of the forest floor on a given site. To use the field card, circle the applicable site conditions, noting that “Soil Matrix” is a combination of “Texture” and “Coarse Fragments.” To determine the soil matrix rating, use the first or top mineral soil horizon that is 15 cm (or more) thick; otherwise use the thickest layer in the top 30 cm of mineral soil. For example, if the Ae horizon is 5 cm thick followed by a Bf horizon of 18 cm, use the texture and coarse fragment content within the Bf to determine the soil matrix rating. Alternatively, if an Ah horizon of 15 cm is underlain by a Bm horizon of 20 cm, use the Ah to determine the rating.
Use the same depth to unfavourable substrate as in the soil displacement hazard assessment.

When recording slope percent for this hazard category, hummocky or gullied terrain is rated equally with slopes greater than 60% because of the increased likelihood of mechanical displacement. Add the total points and circle the hazard rating.

Forest floor displacement is the mechanical dislocation of the upper organic materials by equipment and movement of trees or logs. It involves excavation, scalping, mineral soil exposure, and burial of the forest floor. It can result in nutrient redistribution and potential losses in soil productivity.

Effects on soil productivity range from beneficial to detrimental, depending on site factors (e.g., mineral soil characteristics) and degree of forest floor displacement (e.g., how far the displaced forest floor is from the seedlings).

Refer to Appendix 5 for more information on this hazard.

**Mass Wasting Hazard (Interior only):** This optional assessment helps the surveyor identify areas that call for special consideration during construction of bladed structures or ground-based operations. To use the field card, for all Interior sites, use both parts A and B. If dry ravelling is not a concern, indicate this by recording “n/a” (not applicable) in Part A. Dry ravelling occurs on steep slopes consisting of non-cohesive, granular, and fragmental materials.

In Part B, cutslope and fillslope failure hazard is assessed. Circle the applicable site conditions. For moisture regime, assign fractional ratings, if required, as long as this is defensible. Use the most limiting texture in the soil profile or use the predominant texture grouping that overlies a water-restricting layer (i.e., whichever is rated highest). Add the total points and circle the hazard rating.

The Mass Wasting Hazard is the highest rating obtained from either Part A or Part B. Similar to “Indicators of Potential Slope Instability” (ITEM 46), Mass Wasting Hazard assessment also helps to call attention to areas of concern. If the Mass Wasting Hazard is “Very High,” seek further advice from an appropriately qualified slope stability specialist before proceeding with development of the prescription.

If gully systems greater than 5 m deep are present, conduct an individual Mass Wasting Hazard assessment on each gully system.
Mass wasting is erosion by detachment and transportation due to gravity. In the Interior, mass wasting is a common concern in the wetter BEC zones, such as the ICH, the wetter SBS and ESSF subzones, and the BWBS, but it can be a concern in any zone.

Determining the mass wasting hazard assesses susceptibility to small, disturbance-related slope failures: it is not the same as landslide likelihood, which is determined using the procedures specified in the *Mapping and Assessing Terrain Stability Guidebook*. Mass wasting hazard refers primarily to small-scale failures that cause mainly on-site degradation, while landslide likelihood refers to larger events that may possibly cause off-site impacts. The two hazards are correlated—a very high mass wasting hazard may indicate a potentially unstable slope. In addition, small disturbance-related slope failures can lead to larger landslides through drainage diversion or failure of “stacked” excavations up a hillside, such as those used in switchback road construction.

Several landform types are prone to mass wasting problems, such as:

- glaciofluvial terraces (e.g., stratified sand and gravel) with thin silt or clay layers (slump);
- glaciolacustrine terraces (slump);
- coarse glaciofluvial deposits with slopes close to the angle of repose (dry ravel);
- steep colluvial deposits (dry ravel);
- debris-filled channels and confined snow avalanche tracks (debris torrents); and
- steep morainal deposits (debris avalanches).

Refer to Appendix 6 for more information on this hazard.

44. SOIL HAZARD SUMMARY
From each of the Compaction, Soil Displacement, Soil Erosion, Forest Floor Displacement, and Mass Wasting Hazards, enter the points (excluding Compaction) and rating in the summary table provided.

45. COMMENTS / SOIL PIT
Provide further clarification, where required, on information related to items 27 to 44, inclusive. Indicate the item number to which these comments apply. Circle the item number on the form to alert the reader that further information relating to this item can be found in the “Comments” section. A sketch of the soil pit can be helpful in describing soil layers to persons responsible for construction and rehabilitation of temporary access structures.
46. INDICATORS OF POTENTIAL SLOPE INSTABILITY (COAST AND INTERIOR)

Examine the site for any historic or active indicators of instability problems, and record the types of features, if any, by checking all the indicators observed. Some of these features by themselves may not be cause for concern, for example, curved tree butts (pistol-butts) may indicate snow-creep; mixed or buried soil profiles may result from windthrow; scarred trees on the edges of a gully may be windthrown; fresh rocks on hill slopes may result from grizzly bear digging or blasting upslope. However, they may be a concern when other factors are also present.

Overlooking potential slope instability can result in development decisions that greatly increase the risk of slides or erosion events that may create unacceptable damage to productive forest land, water quality, property, and even risk to human life. The primary purpose of the list of slope stability indicators is to assist the surveyor in identifying possible terrain instability that may not be shown by mapping at the FDP stage. Information in the FDP is normally based on terrain stability mapping at the detailed or reconnaissance level. Depending on the survey intensity level (TSIL) of this mapping, it is likely that small-scale features may have been missed. The typical number of field checks during detailed terrain mapping is usually no greater than one per square kilometre, and the smallest mappable polygon is about 4 ha. Also, some small-scale terrain instability features are not visible on air photos as they may be obscured by forest cover.

The presence of the following slope failures indicates a serious slope instability problem.

• tension cracks (fractures) on hillsides (Figure 27)
• old slide scarps or slump headwalls (Figures 27 and 28)
• existing landslide tracks or initiation zones (Figures 27 and 28)
• scoured stream channels or gullies (Figure 29)
• debris deposits in channels (Figure 29)
• debris deposits on or below open slopes (Figure 29)
• tilted or jack-strawed trees from soil movement
• seral vegetation succession on a slide (e.g., slide alder; not to be confused with snow avalanches)

If a TSFA has not been required for a cutblock based on terrain stability mapping, and indicators of terrain instability are present, then FPC regulations require that a TSFA be conducted. The forester responsible for a FDP or SP must determine whether features observed by field crews constitute an indicator of potential slope instability, as defined by FPC regulations, and if so, to ensure that a TSFA is conducted. If in doubt, the forester should have...
Figure 27  Slump/earth flow features (adapted from Varnes 1978).

a) Debris flow/torrent: very slow to rapid

b) Debris avalanche: very rapid to extremely rapid

c) Debris slump: very slow to rapid

Figure 28  The three principal types of shallow slope failures in surficial deposits (Varnes 1978).
figure 29 Characteristics of a moving debris flow: (a) longitudinal section showing variable concentration of solids and vertical velocity gradients in different parts of the flow; (b) cross-section through debris flow in motion, indicating central plug and marginal dead zones; and (c) cross-section of torrent channel after passage of debris flow (note debris left behind by the flow) (adapted from Eisbacher and Clague 1984).
a TSFA done, or should seek the advice of a qualified registered professional
with expertise in terrain stability, to help decide if a TSFA is required.

**Note:** If there are any slope instability indicators in Coastal areas, also
refer to A Guide for Management of Landslide-Prone Terrain in the
Pacific Northwest (Chatwin et al. 1994).

Seven broad categories have been assigned to instability features. These are
landslide, vegetation, slope, soil, bedrock/rockslide, road, and gully features.

1. **LANDSLIDE FEATURES**

   **Recent landslide scars:** Obvious evidence of downward and outward move-
   ments of slope materials (e.g., debris avalanches, debris flows, or slumps); usually
   associated with a fast rate of falling; strong indicator for potential slope instability. Debris
   flow is a type of landslide characterized by water-charged material flowing rapidly
   down a pre-existing channel; also known as debris torrent or mudflow (see Figures 28 and 29).
   A slump is a type of landslide characterized by the curved backward rotation in a mass of soil
   (see Figure 28).

   **Revegetated landslide scars:** Vegetation has re-established on a landslide, as
described above; strong indicator for potential slope instability.

2. **VEGETATION FEATURES**

   **Partially revegetated strips:** Seral vegetation is oriented up and down slopes
   (but not due to snow avalanches), or is oriented with slope features; see
   “Slope Features,” below.

   **Jack-strawed trees, split trees:** Trees tilting in one or a number of directions
   provide clear evidence of slope movement (unless obviously attributed to
   root rot or windthrow). Split trees have stumps/boles that have cracked or
   split due to soil creep.

   **Linear strips of even-aged timber:** Younger trees are oriented up and down
   slopes (not due to avalanches), or are oriented with slope features; see “Slope
   Features,” below. Veterans are usually lacking.

   **Curved or sweeping (pistol-butt) trees:** Curved trees are good indicators
   of slope movement (temper this interpretation in areas of heavy snowfall). A good
   rule of thumb: if the curve occurs only at the very bottom (i.e., a true “pistol-butt”),
   snow rather than slope instability might be the cause; if the curve sweeps gradually
   up the tree, this suggests an ongoing soil creep problem.

   **Wet site vegetation on slopes > 50%:** Moisture-indicating plants on steep
   slopes often provide strong evidence of high groundwater levels, which will
influence slope stability. Some of the most common plants to look for are alder, horsetail, devil’s club, cow-parsnip, and skunk cabbage.

3. SLOPE FEATURES

**Landslide debris piled on lower slope:** An accumulation of loose, predominantly coarse-grained soil and rock fragments, sometimes occurring with large organic material, such as limbs and trunks of trees, which is mixed together in an unsorted fashion; found on lower slopes or depositional lobes (Figure 29), or piled on gentler slope segments or lower slopes; by itself, a strong indicator of slope instability. Often revegetated or reforested.

**Tension fractures:** Tension fractures are cracks in the ground surface caused by tensile stresses; often found at the head of a landslide (Figure 27) and are a serious indication of soil movement; may appear fresh (e.g., sharp edges, roots stretched across crack, trees or stumps split) or older (e.g., steps or gaps running across slope, bigger roots bridging or split across these fractures).

**Numerous springs at toe of slope, sag ponds:** Areas of concentrated subsurface water flow or ponding water on benched or stepped slopes are potential sites of active, unstable ground.

**Curved depressions:** Small, spoon-shaped depressions occur in the slope (e.g., the soil appears to have discharged from a miniature head scarp [Figure 27]); trees look like they are riding downslope on “islands”; most of the soil associated with windthrow (“tree-churns”) have moved downslope. A scarp is a steep surface directly below the undisturbed ground above a landslide (caused by the landslide).

**Shallow, linear depressions:** Areas of concentrated surface and subsurface water flow oriented up and down the slope. These landslide scars or erosion channels on hill slopes are common points of origin for debris avalanches and debris flows.

**Step-like benches or small scarps:** Scarps, benches, troughs, or narrow ridges occur along the contour with no obvious geologic explanation (e.g., these features may look like some ancient culture built a road there—distinguish from possible historical or First Nations trails, which are typically much narrower). Terracettes are a series of very long and narrow terraces, often discontinuous, that run parallel to the contour of a slope and often occur in groups; usually produced by very local, surficial slumping.

**Displaced stream channels:** Channels laterally displaced at the base of a landslide; usually pushed to the opposite side of the valley or fan. Also, streams flowing haphazardly across (or discontinuous channels in) old landslide deposits or lumpy, open slopes.
Ridged marine deposits: Large slide deposits immediately offshore from the ocean visible from above or on aerial photos; can also occur around larger interior lakes.

4. SOIL FEATURES

Soil and rocks piled on the upslope side of trees: Extra woody debris, thick forest floor, or soil debris accumulating on the uphill side of trees; stump height differences seem exaggerated up and downslope; hollows may appear under roots on downhill side.

Mixed or buried soil profiles: Mixed soil profiles in soil pits provide strong evidence of soil movement. Check a few more locations; isolated occurrences may be attributed to windthrow or animal burrows.

Poorly developed soils relative to other comparable slopes: Soils that have weaker or no soil development when compared to neighbouring, more stable areas (e.g., Regosols in an area that normally has Podzols indicates that the soil parent material was recently exposed); by itself, a strong indicator of slope instability.

Shallow, wet, organic soils on slopes > 40%: Very thick forest floors (> 25 cm) with seepage, or organic soils occurring on steep slopes (> 40%), indicate that enough moisture is present to cause potential instability problems. The surface soil and forest floor may actually be moving downslope; finer-textured or dense soils often occur at depth.

Poorly drained medium- to fine-textured materials > 3 m deep: Cohesive materials (medium to fine textured) can accumulate large amounts of water and become unstable; prone to creep, slump, and earthflow. Creep is an imperceptibly slow, more or less continuous downward and outward movement of slope-forming soil or rock. Slump is the downward slipping of a mass of rock or unconsolidated material of any size, moving as a unit or as several subsidiary units, usually with backward rotation. Earthflow is a slow flow of earth saturated with water.

5. BEDROCK / ROCKSLIDE FEATURES

Talus or scattered boulders at base of slope: Talus is a collection of fragmental material on or below a steep slope. The angle of repose (maximum stable slope angle) for talus usually averages 35–40° (70–80%).

Rock faces with freshly exposed rock: Indicated by fresh rock accumulations at the base of the slope or by fresh cliff faces with little or no moss or lichen growth; steep rock cliffs represent potential sites for rockfalls and rock slides. Inspect cliffs and steep bedrock outcrops for evidence of fresh or
recent movement. Look below the outcrop for large boulders or blocks of rock resting on overburden or talus rock.

**Steeply dipping bedrock discontinuities that parallel the slope:** Bedrock occurring in layers that are steeply inclined out of the hill slope; are often prone to topple failure or slippage. Dip is a geological term for the angle that a planar feature (i.e., bedding plane) makes with the imaginary horizontal plane.

**Bedrock joint or fracture surface intersections that dip steeply out of the slope:** Joints or fractures dipping out of the slope, or parallel to the slope, that can result in failure from gravitational forces, frost, or disturbance; allow water to concentrate, which can cause pressure-induced failure, or result in springs developing at remote sites on the slope. A fracture is any break or discontinuity in a rock. Fractures include cracks, joints, and faults. A fault is a fracture in rock along which movement has occurred.

6. **ROAD FEATURES**

**Bulges in road:** Deformation of road surface attributed to slope movements; may appear as “speed bumps” or drops in the road surface.

7. **GULLY FEATURES**

**Poorly drained or gullied fine-textured materials < 3 m deep on slopes > 50%:** Fine-textured materials (clay in texture) with high moisture content on steep slopes; prone to creep, slump, and earthflow; these shallow materials can become quickly saturated and unstable.

**Poorly drained or gullied coarse-textured materials on slopes > 50%:** Non-cohesive materials (coarse textures low in clay; cannot roll a “worm” when hand texturing) on steep slopes, prone to debris avalanches and debris flows, even in the absence of excess moisture.

**Recently scoured gullies:** Gully floor scoured clean of sediment and woody debris; U-shaped channel cross-section; scouring typically occurs on slopes of more than 18%; by itself, a strong indicator for slope instability.

**Vegetation in gully much younger than the adjacent forest:** Trim lines in the surrounding mature vegetation with younger vegetation and trees along the floor and lower sides of the channel. A trim line is a line along a gully, stream, or river channel where erosion is readily apparent by the removal of larger, older vegetation. Very fluid debris can run through trees; look for a lack of moss on the ground, or fresh soil and mud on the lower parts of tree trunks.
Exposed soil on gully sides: A sidewall scar that may have a deposit below, or a channel empty of sediment and debris below the scar.

Debris piles at the mouths of gullies: Piles, lobes, and levees (Figure 29) of debris are composed of large woody debris and mixed deposits in the deposition zone; indicative of past debris flows upslope. A levee is a bank of sediment, bordering one or both sides of a gully.

Poorly developed soils on gully sides relative to adjacent slopes: Young, shallow soils (a result of repeated gully wall failure over time), compared with adjacent slopes, where gullies develop in deep tills or glaciofluvial materials; also found on floors of active gullies.

8. OTHER INDICATORS
If other indicators of instability are observed in the field, but not listed in the above sections, record them here. Further indicators of instability include the following.

Piping: A form of subsurface erosion in which holes from a few centimetres to a metre in diameter develop (most commonly in glaciolacustrine stream banks, gullies, or draws near edge of terraces); is associated with temporary saturation and subsurface erosion, or high salt content in soils; in some cases, initiated by animal burrows; horizontal erosion or vertical sinkholes are often visible in road cuts and scarps in silty, fine-textured, or sandy non-cohesive soils; may look like mine fields.

Extensive seeps / springs: Two or more seeps, or springs, per 100 m occurring across the contour above toe-slope locations; often indicate moisture levels that can influence instability.

Heavily faulted or folded / fractured rock formations: Rock that is not solid, as observed in burrow pits or on road cutbanks; contains fractures along which movement has occurred.

Extensive or retrogressing cutbank failures (Interior only): Roads, skid roads, or landings with continuous areas of failing cutbanks, or failures that keep moving upslope every year, often indicate serious slope instability at an Interior site; may be due to excessive soil moisture; can cause drainage diversions, leading to larger landslides.

Tension cracks in middle of road: Cracks occurring mid-road or along the inner track (rather than sidecast); indicate subsoil failure.

Clay-rich glaciolacustrines < 3 m deep on slopes > 40%: Fine-textured materials with high moisture content on steep slopes; may be prone to creep,
slump, and earthflows; shallow materials can become quickly saturated and unstable.

**Mottled or gleyed soils on slopes:** Reddish mottles in a bluish grey matrix, if prominent, indicate a high water table; groundwater is a primary factor in slope failures.

*Note: If slope instability indicators are present, a terrain stability field assessment must be carried out to the satisfaction of the district manager.*

47. COMMENTS / DIAGRAM
Provide further clarification, where required, on information related to item 46, or use this area for a diagram (profile of soil pit, sketch map indicating location or nature of instability features, etc.).

3.2.2 Silviculture Prescription Stratum Card (FS 39B)
When the information from the field assessment and the detailed sample plots have confirmed your strata, complete a stratum card (FS 39B) for the area. This helps to summarize prescription issues for a proposed Standards Unit and ensures that you consider as many prescription factors as possible while still in the field. Use common sense when completing this card: record field observations relevant to the SP (which must recognize local resource value concerns). Ignore sections that are not relevant to the SP, or any factors already assessed (e.g., stream or gully assessment). For instance, do not write up information that is irrelevant to the local resource issues or that is already available from the office review, unless you need to confirm it. Observe and be watchful for clues relating to all factors mentioned on the stratum card (e.g., similar, older cutblock areas nearby can provide useful insights). Also, do not hesitate to collect any additional data items, not included on this card, that may be necessary to support the prescription.

**REFERENCE DATA**

1. LICENCE NO.
Record the tenure number (FL A01234, TFL018, etc.).

2. LICENSEE
Record the person or company name of the tenure holder, not the contractor name. If Small Business Forest Enterprise Program, record as such.

3. CUTTING PERMIT (C.P.)
If applicable, and known, record the cutting permit number.
4. BLOCK
Record the cutblock number of the cutting permit for this SP. Use this data field to record the Ministry of Forests opening number for areas that were created by means other than harvesting.

5. STRATUM AREA (ha)
Record the area, in hectares, of the stratum.

6. STRATUM
Record the stratum (e.g., A, B, C) to which the field data is applicable.

7. SURVEYOR(S)
Record the name(s) (not initials) of the person(s) who collected and recorded the SP field data. Record the field assessment date.

8. PLOT NUMBERS IN STRATUM
Indicate the appropriate plot numbers from Plot Card FS 39A that relate to this stratum.

SITE DATA

The silviculture prescription must describe the biogeoclimatic ecosystem classification and any critical site conditions that would affect the timing, or manner, of operations.

9. BGC ZONE, SUBZONE, VARIANT
Indicate the biogeoclimatic zone, subzone, and variant(s) existing in the stratum. Record as codes, using those presented in the regional ecological field guide. For example:

<table>
<thead>
<tr>
<th>ZONE</th>
<th>SUBZONE</th>
<th>VARIANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESSF</td>
<td>dc</td>
<td>1</td>
</tr>
<tr>
<td>IDF</td>
<td>xh</td>
<td>2</td>
</tr>
</tbody>
</table>

Record transitions between subzones or variants, if they are present.

Phase: If applicable, record the recognized “phase” descriptor provided in the regional ecological field guide (e.g., IDF xh2a).

Site Series: Use the regional ecological field guide to determine and record the numeric site series (e.g., 01, 02) for the area.
If the stratum is compound, indicate the percent composition of each site series (e.g., site \(03 = 60\%\), site \(04 = 30\%\), site \(02 = 10\%\)). Then, describe in Item 12 how these are positioned in the landscape so that they can be recognized and managed.

10. ELEVATION (m)
Record the minimum and maximum elevation of the map stratum in metres based on representative plot and transect observations. Measure elevation with an altimeter, which is set daily to a known elevation benchmark.

11. SLOPE (%)
Record the minimum and maximum slope gradients and the predominant slope gradient in percent based on representative plot and transect observations. Measure slope using a clinometer or Abney level.

12. CRITERIA-DEFINING STRATUM
Outline the criteria used to delineate and define the stratum being described. This may be the biogeoclimatic site series, a forest health factor, soil sensitivity, or stand management objectives, or some combination of criteria.

RIPARIAN / WATERSHED VALUES

Field check all water bodies identified during the office preparation and mapping phase. In the silviculture prescription a riparian class (if applicable) must be provided for each stream, lake, and wetland in the prescription area, including any not identified during the office preparation and mapping phase. The known lake classification must also be provided for any lake in, or adjacent to, the prescription area. Provide a map to illustrate all streams and wetlands in, or adjacent to, the area, as well as the associated riparian class. Definitions follow throughout this section, for all data collection entries located in the riparian section of the stratum card.

- **Stream** – Any reach, flowing on a perennial or seasonal basis, with a continuous channel bed (whether or not the bed or banks of the reach are locally obscured by overhanging or bridging vegetation or soil mats) that is either scoured by water or contains observable deposits of mineral alluvium.

  Ephemeral streams have defined channels, but flow for only part of the year, usually in winter and spring in Coastal drainages, and in spring and early summer in Interior ones. Ephemeral streams of less than 20% gradient may be fish streams.

  Six riparian classes (S1 to S6) of streams are based on the presence of fish, occurrence in a community watershed, and the average channel width.
• **Stream channel width** – The horizontal distance between the tops of the stream banks as determined by the normal high water mark on opposite sides of the stream, measured at right angles to the general orientation of the banks.

• **Reach** – A length of a watercourse having similar channel morphology, channel dimension, and gradient.

• **Fish stream** – Any stream reach frequented by any of the following species: anadromous salmonids, rainbow trout, cutthroat trout, brown trout, bull trout, Dolly Varden char, lake trout, brook trout, Kokanee, largemouth bass, smallmouth bass, mountain whitefish, lake whitefish, arctic grayling, burbot, white sturgeon, black crappie, yellow perch, walleye, northern pike, or identified threatened, endangered, or regionally important fish determined under of the provisions in the *Operational Planning Regulation*. All reaches of streams that have a slope gradient of less than 20% must be identified and mapped as fish streams, unless a fish inventory, carried out in accordance to the *Fish-stream Identification Guidebook*, demonstrates that none of the fish species listed above is present. (If further guidance is required, contact the local Ministry of Environment representative.) This 20% gradient rule for “default” fish-bearing status does not apply when the following three conditions occur:
  • the stream is located upstream of a known barrier to fish passage, identified on a fish and fish habitat inventory map;
  • all reaches upstream of the barrier are simultaneously dry at any time of the year; and
  • no perennial fish habitats exist upstream of the barrier.

• **Riparian Reserve Zone (RRZ)** – An area of specified width located adjacent to a stream, wetland, or lake within a Riparian Management Area, as determined by Part 8 of the *Operational Planning Regulation* (see “Note” below). Harvesting is not permitted except in special circumstances that require joint approval by the district manager and a designated BC Environment official.

• **Riparian Management Zone (RMZ)** – An area of specified width located adjacent to any riparian reserve zone, or if there is no riparian reserve zone, located adjacent to a stream, wetland, or lake within a Riparian Management Area as determined by Part 8 of the *Operational Planning Regulation* (see “Note” below). Constraints to forest practices apply.

**Note:** Part 8 of the Operational Planning Regulation provides for minimum widths only. It is up to the surveyor and prescriber to ensure that the widths chosen are adequate to meet the riparian management
objectives. If the minimum widths specified in the Operational Planning Regulation are not of adequate size to manage for riparian objectives, recommend a wider zone. For example, larger reserve or management zones may be necessary in areas prone to high windthrow hazard.

13. STREAMS
If not already identified and classed by a stream classification assessment, provide an identifier (distinct name, number, etc.: standard water body identifiers and watershed codes are preferred) for each stream or reach in the stratum.

- Describe the approximate length of the reach and determine the average channel width in metres.
- Provide the average gradient along the length of each reach.
- Is the stream frequented by fish? Record “Y” for yes, “N” for no, and “?” for unknown.
- These descriptors will help determine the riparian class (see Table 7) for the stream or reach.
- When assigning the stream class to a reach as S1, S2, S3, S4, S5, or S6, specify whether the class was based on an approved fish inventory or on gradient criteria alone.
- Using the riparian classifications in Table 7, or field cards FS 900A (Coast) or FS 900B (Interior), determine the applicable Riparian Reserve and Riparian Management zones for each stream or reach identified.

The Riparian Management Area Guidebook and the Fish-stream Identification Guidebook will provide further details on this topic.

14. OTHER WATER BODIES / NUMBER AND TYPE OF WATER BODY
Check which type(s) of water body exist in the stratum and indicate the number (by type) on the adjacent line. Refer to the definitions for water bodies below.

- **Lake**: A naturally occurring, static body of fresh water (> 2 m deep and > 0.25 ha in size), or a licenced reservoir.

The four riparian classes (L1–L4) for lakes (Figure 30) are based on lake size and the biogeoclimatic unit in which they occur (see the Riparian Management Area Guidebook for definitions).
Wetland: A swamp, marsh, or other similar area supporting natural vegetation that is distinct from the adjacent upland areas; must have both hydrophytic vegetation and subhydric to hydric soils.

The five riparian classes (W1–W5) for wetlands are based on whether the wetland is simple or complex (see the Riparian Management Area Guidebook for definitions), wetland size, and the biogeoclimatic unit in which they occur (Figure 31).

Spring: An area where the water table is higher than the surface on a slope microsite, creating a running water source at that location (may return subsurface downslope); can be ephemeral or perennial; can also occur on flat ground (artesian spring). There is no defined, continuous stream channel bed. Riparian classes do not apply.

Seep: An area where the water table is at the surface, creating a water-saturated soil condition evident by hydrophytic vegetation, thick forest floors or organic soils, standing surface water, or seeping conditions. There is no defined, continuous channel bed. Riparian classes do not apply.

<table>
<thead>
<tr>
<th>Identify if:</th>
<th>Riparian class</th>
<th>Average stream channel width (m)</th>
<th>Reserve Zone</th>
<th>Management Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish Stream</td>
<td>S1: large rivers$^a$</td>
<td>$\geq 100$</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>or within Community Watershed</td>
<td>S1: except large rivers</td>
<td>$&gt; 20$</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2</td>
<td>$&gt; 5 \leq 20$</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S3</td>
<td>$1.5 \leq 5$</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S4</td>
<td>$&lt; 1.5$</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Neither of the above</td>
<td>S5</td>
<td>$&gt; 3$</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>S6</td>
<td>$\leq 3$</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

$^a$ A stream greater than 1 km long, greater than 100 m wide, and with an active floodplain greater than 100 m wide.

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**TABLE 7** Specified riparian zone widths for stream riparian classes (B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks 1995)
Off-channel / Intermittent: Areas that provide aquatic environments permanently or seasonally; include ephemeral (intermittent) tributaries, side channels, or flood channels of the main stream, swamps (flooded woodland), sloughs (marsh or mixed woodland), valley-wall base ponds, lakeshore areas, sites dammed by beavers, and other flooded areas within the floodplain apart from the main stream channel. Appropriate riparian classes pertaining to streams, lakes, and wetlands can be assigned, if necessary.

Fisheries-sensitive Zones (FSZs) – Often called “off-channel habitats” because these drainage features do not meet the definition of a stream. These sites are usually floodplain features that occur in close association with stream channels and lakes (e.g., flooded depressions, ponds, or swamps) and are occupied by fish at least some time during the year. Many features qualify as FSZs. They may be
small (< 0.1 ha), ephemeral, or intermittent drainage features that are especially difficult to detect when dry. They may also include major floodplain features that cannot be classified as streams because of channel bed discontinuities or insufficient presence of either scour by water or deposits of mineral alluvium (e.g., flooded woodland swamps, sloughs of marsh or mixed woodland, valley-wall base ponds, and small watercourses). Fisheries-sensitive Zones are protected through appropriate practices outlined in the Timber Harvesting Practices Regulation (sections 10, 12, and 23); it is helpful to include these on SP maps and flag them in the field before harvesting.

COMMENTS FOR ITEMS 13 AND 14

For any water body identified in the stratum, describe and, if necessary, assign an appropriate Riparian Reserve and Riparian Management Zone width. If the riparian vegetation is distinct from the surrounding forest, describe its structure, species composition, and other defining characteristics. Vegetative cover in the IDF, ICH, PP, BG, and CDF biogeoclimatic zones can be especially important in maintaining water temperatures tolerable to fish.

Include any special management considerations (i.e., any proposed forest practices within a reserve or management zone, any wildlife habitat areas, or any proposed group reserves, including wildlife trees) for a given Riparian Management Area. Where harvesting is proposed within a riparian or lakeshore management area, the prescription must also include strategies to protect stream banks and to maintain shade over known, temperature-sensitive streams.

• **Bank/Streambed Materials** – Describe bank configuration by noting height and average gradient in percent, whether the bank appears stable or shows signs of recent erosion, and whether windthrow is evident. This information is not mandatory, but may be useful when assessing channel and bank stability. It will also help when identifying appropriate management options.

Record the predominant substrate type in the streambed. Substrate type can be described by any, or a combination, of the following: organics, fines, gravels, cobbles, stones, or bedrock.

Record the frequency, location, and size of log jams, anchored woody debris, overhanging banks, or vegetative cover. The stability of some stream channels and stream banks depends on the continued presence of woody debris and live tree root networks in the channel and bank.
Do any of the water bodies identified in the stratum flow directly into, or connect with, fish-bearing water bodies? If so, identify which water bodies these are, and record the distance to the fish-bearing water body. Determine if a riparian class is applicable using the *Riparian Management Area Guidebook*.

If fish or fish habitat are present, record and describe the fish species and the water body concerned. If Marine- or Fisheries-sensitive zones are present, describe them.

*Note: Important references for completing this section include the Riparian Management Area Guidebook and Fish-stream Identification Guidebook.*

15. **GULLIES (OPTIONAL FOR INTERIOR SITES)**

For Coastal locations, if gullies greater than 3 m deep have not already undergone an assessment, then completing the Coast gully table on the stratum card will provide some necessary information to evaluate any hazards associated with the gully. Refer to the *Gully Assessment Procedure Guidebook* for more detailed coverage.

For Interior locations, gully systems >5 m deep should be typed out and addressed separately for soil disturbance hazard assessment during data collection.

If harvesting is proposed within a gully, the prescription must describe management strategies that are consistent with the completed gully assessment. Record any special management considerations that may be applicable in the comment section above item 15 (e.g., if proposed, falling and yarding away from gullies; protecting gully banks; minimizing damage to the understorey; addressing sediment and debris transport potential and debris management).

- **Gully** — An area, whether containing a stream or not, where the overall gradient is at least 25%, and a reach of that gully (> 100 m long) has:
  - a side wall greater than 3 m,
  - a side slope greater than 40–50%, and
  - a channel gradient greater than 20%.

Riparian classes are not assigned to gullies; however, a detailed assessment, following procedures set out in the *Gully Assessment Procedure Guidebook*, will help to rate any hazards within the gully that may be affected by management activities, and to identify hazards to downslope resources.
Gully No.: Identify each gully system by a separate identity code. If the gully has more than one segment, identify each one separately: separate descriptions are required for each gully segment. A map recording each gully number would be useful.

Channel: Suggested information to collect about gully channels includes:

% Gradient: Indicate the overall gradient of the channel (or segment) as a percent slope over a minimum distance of 40 m.

Width (m): The full width, in metres, of the gully, top bank to top bank.

Depth (m): The full depth, in metres, of the gully, from a horizontal line spanning the gully from bank tops to the bottom or floor.

Length (m): The length of the gully segment, in metres.

Surficial Materials: Assess and record the materials in the gully channel and/or sidewalls as either rock (R), colluvial materials (C), morainal and fluvial materials (M or F), or marine and lacustrine materials (W or L). Fluvial materials include glaciofluvial deposits. Lacustrine materials include glaciolacustrine deposits. Surficial materials differ in their slope failure potential.

Debris Torrent: Indicate any evidence of a debris flow (e.g., levees, plugs/lobes, sidewall scar) or a landslide within the gully. Qualify whether it is recent or older. Past debris-flow activity is a good indicator that the potential exists for future debris flows.

Gully Wall: It is important to record % slope and height of gully walls. If height varies, record information for the highest side.

% Slope: Measure and record the slope percent from the base of the gully to the top. Do not confuse with the gully percent gradient. In gullies consisting of a steeper inner gully located within an outer gully, measure the inner gully slope percent.

Height (m): Measure and record height from the bottom of the gully to the top at the slope break in the same location where the gully slope angle is measured.

16. WATERSHED VALUES
Consider and discuss how the prescription for the stratum may influence surface erosion, natural drainage patterns, and the water table. Any prescribed treatments should minimize the potential for alteration of natural drainage patterns and surface runoff. Consider whether your planned access
route(s) will channel water. Note any actions needed to protect watercourses and water quality, such as harvesting modifications, culvert location and size, and riparian reserves. This is particularly important if the stratum falls within a community watershed, or has licenced or unlicenced downstream water users. Do any of the water bodies identified not connect directly with a sensitive watercourse?

Water quality is influenced by erosion, landslides, avalanches, soil and geological parent material, vegetation, climate, season, and human activities. High water quality is promoted primarily by reducing suspended sediments. Suspended sediments can be minimized in riparian areas by special management and by advanced planning in the location and construction of access routes.

Sedimentation (of eroded and transported fines and coarser materials) is accelerated by the following forest activities: the construction, use, and maintenance of access routes (including bladed trails); harvesting practices including felling, skidding, decking, loading, and hauling; livestock grazing; and recreation activities, such as operating all-terrain vehicles and camping. Practices less likely to cause sedimentation, but that may in localized, sensitive areas, include skidding, site preparation, and felling.

RESERVES

Reserves can take on numerous forms: they can be single trees (e.g., green trees or “safe” wildlife trees), forested patches (e.g., for wildlife, seed, unstable ground, hydrologic purposes), or areas surrounding an important feature (e.g., lakes, streams, scenic). Reserves are maintained for at least one rotation. If trees are to be retained for short periods of time (e.g., seed or shelterwood trees), they should not to be recorded as reserves. Reserves will not normally be subject to harvest entries, except in special circumstances. These are authorized by joint approval of the district manager and a designated environment official. For example, harvest entries may be required and planned to meet a management objective such as forest health or a specific type of riparian class.

Many reasons exist for including any type of reserve within the SP area. Reserves can be established to provide:
- cover and sustenance for wildlife and fish;
- recruitment of coarse woody debris;
- nesting sites for birds;
- protection (e.g., rare plant associations, important wildlife habitat, archeological findings, historical values, cultural values, sensitive sites, wind-prone areas, scenic values, areas of historical livestock use);
- fire breaks (for fuel management); or
- riparian values.
The above constitute only a few examples of reserves.

17. RESERVES
Indicate whether or not reserves will be applicable to the stratum (i.e., within or adjoining). To be classed as a reserve, the area must be designated for long-term retention (no harvest entry for one rotation). If applicable, describe the type of reserve and explain the need for it. For example:

- **Wildlife tree reserves (WTRs)** – should include a description of the features and values they contain, as well as the need for them. Indicate approximate numbers, species, and distribution (see discussion of WTRs in the *Landscape Unit Planning Guide*).

- **Single wildlife trees** – should be described by their dbh (cm), height (m), number per stratum, distribution (group, uniform, variable), function or purpose, and as dead, live healthy, or live unhealthy. Further comments can relate to present use by wildlife, proximity to riparian areas, hardwood patches, rock outcrops, etc.

- **Timber management reserves** – might describe the wood quality and piece size for trees left for an extended rotation.

- **Riparian reserves** – must meet the minimum criteria outlined in the *Riparian Management Area Guidebook*.

HAZARD / INSTABILITY

18. SOIL HAZARD / INSTABILITY SUMMARY
The SP must address issues of soil compaction, surface soil erosion, and soil displacement wherever ground-based operations are planned. Provide a summary of the compaction, soil displacement, and surface soil erosion characteristics of the stratum by providing the range for all plots located in that stratum. Assessing forest floor displacement hazard is a recommended option in some interpretive guides. In addition, for the Interior, providing the mass wasting hazard rating is an option that should be considered. If a range of ratings or points occurs for any one factor, provide the range.

Referring to all plot cards and ancillary notes completed for the stratum, indicate by a Yes or No whether slope instability indicators are present.

**Note:** If slope instability indicators are present, a terrain stability field assessment must be carried out to the satisfaction of the district manager.

19. FIRE HAZARD ABATEMENT
If a fire hazard (from concentrations of slash) is expected to increase after harvesting, discuss the actions necessary and time frame required to abate the hazard.
Consider the nature of the existing fuel complex (e.g., windthrow, snags, woody debris) and the fuel loading, along with nearby sources of ignition (e.g., nearby campsites, major access routes, lightning incidence). Predict how harvesting will affect the fire hazard. Management options that can affect fuel management include: modifying the shape, size, and orientation of a cutblock; mechanically preparing the site to break up or redistribute slash; leaving fire breaks; and prescribed burning.

Hazard abatement activities must be consistent with higher-level plans and conducted according to a burning plan or smoke management plan, but it is unnecessary to outline specific activities in an SP; to help with the overall prescription process, the surveyor just needs to identify apparent fire hazard abatement concerns. The Fire Management Guidebook provides assistance in quantifying fire hazard and describing hazard abatement methods.

20. WINDTHROW HAZARD

Note whether wind damage is evident in, or adjacent to, the stratum by the presence of any of the following:

- **Stem break** – The bole of the tree snaps well above the ground; occurs more frequently during strong gales and hurricane-force winds, or heavy snow loading with strong winds, particularly on sites where good root anchorage occurs, and in trees that have been weakened by disease.
- **Stock break** – The bole snaps at ground level.
- **Root break** – The tree is uprooted by pivoting on broken roots directly beneath the bole; typically occurs in trees with small root systems, trees with root rot, or trees growing in sandy or wet soils that have a low shear strength.
- **Tree throw** – The tree is uprooted by pivoting on the outer edge of a massive plate comprised of soil and roots; occurs more commonly in trees with a shallow, plate-like root system on very wet sites, or on shallow soils.

When assessing the windthrow hazard of a specific site, consider the following factors:

- aspect
- topographic position (macro- and mesoscale)
- elevation
- percent slope
- bedrock type/physiography
- soil classification (e.g., texture)
- humus depth
- soil depth
- rooting depth
• soil drainage
• presence of root or butt rot
• cutblock boundary orientation and shape
• size of cutblock
• tree species
• dbh and density
• stand height and tree age
• prevailing winds
• historical storm patterns

The importance of these factors will depend on the local conditions.

Refer to the *Windthrow Handbook for British Columbia Forests* (Stathers et al. 1994) for a more complete discussion on windthrow.

**SILVICULTURAL SYSTEMS / OBJECTIVES**

21. **SILVICULTURAL SYSTEMS / MANAGEMENT OBJECTIVES**

State the management objectives and determine the range of silvicultural systems that are ecologically suited to the site. Specific stratum objectives must be compatible with the resource management objectives stated in higher-level plans and forest development plans.

Surveyors should demonstrate that they understand the planned management objectives for the area. Consider the general site description (BEC site series, soils, vegetation, etc.), as well as the concerns for the other potential limiting factors (climate, brush, fire, pests, etc.). All other resource values must be considered.

Evaluate the silvicultural system for its ability to maintain site productivity and promote forest health. Also consider the system’s silvicultural feasibility (future stand composition and structure, residual basal area) and its harvest feasibility (including protection of reserves and designated understorey).

The choice of a silvicultural system must also involve the consideration of social and economic factors, along with necessary Workers’ Compensation Board (WCB) regulations.

An SP must describe the proposed silvicultural system. For all silvicultural systems, the desired post-harvest stand structure and site condition must be stated in the prescription, as well as the species and function of trees that will be left standing.

The *Silvicultural Systems Guidebook* provides guidance and instruction on selecting an appropriate silvicultural system.
22. HARVESTING

Specifying type of harvesting system is not required in the Silviculture Prescription. However, the SP must describe any critical site factors that may affect the timing of operations and the manner in which timing will be affected. Timing may be described in terms of seasonal site conditions (e.g., the desired/appropriate soil moisture, frost, or snow condition during which operations should occur). While still in the field, it is useful to indicate the most appropriate harvesting system(s) for the stratum, and to elaborate on how this system will help to achieve the desired post-harvest conditions.

When proposing a harvesting system, consider the soil disturbance hazards, the identified resource values and limiting factors, and the future tree species and stand structure. Whenever possible, indicate more than one harvesting system to provide flexibility and to possibly reduce the need for any future amendment(s) to the SP.

For ground skidding the preferred strategy might be designated trails at a spacing compatible with soil conservation objectives (e.g., 30 m followed by some rehabilitation to keep final disturbance below 10% on a moderate disturbance hazard site). Alternative strategies might include dispersed skidding when, and if, soil conditions become favourable. This combined strategy usually guarantees success in terms of maximizing the operating season while still ensuring soil conservation. Judicious use of feller-bunchers (e.g., turning only on trails) can also be accommodated (see Curran 1999).

For another example, timber in a narrow, wet depression is surrounded by dry ground suitable for summer skidding. The harvesting options in this case could include the following.

- Log during winter when the soils are frozen or covered with a protective snowpack.
- Directionally fall and hoe forward the timber to where it can be ground skidded outside of the wet depression.
- Use long-line extraction from outside of the wet depression.

Record any OPERATIONAL CONSTRAINTS for different harvesting techniques. Harvesting concerns might involve: steepness of the terrain; potential barriers; limitations to landing size or location and machinery type; WCB requirements; season of operations; and skid trail patterning.

On most blocks, the harvesting constraints will be determined by the highest soil hazard rating. Refer to the soil hazard/instability summary (item 18) for plots located within the stratum.
Although this section is not intended to be the logging plan, discuss whether the PROPOSED ROUTES (roads, landings, excavated/bladed trails, etc.) pose any engineering concerns. These concerns would include slope instability features, cuts and fills, site disturbance, machine limitations, and culverts. Note any problem locations, such as rocky areas, riparian areas, gullied sections, etc.

FOREST HEALTH

23. FOREST HEALTH FACTOR INCIDENCE
In the table provided, list any forest health factors (biotic and abiotic) noted in, or adjacent to, the stratum. Indicate the tree species affected (i.e., host trees).

Estimate, from a walk-through, the percent incidence of the pest in the overstorey layer by recording the percentage of host trees affected and then the percentage of total trees affected, or the percentage of the total area affected, depending on the type of agent. Refer to any previous survey information (e.g., root rot survey). Indicate the magnitude of risks as low (L), moderate (M), high (H), or very high (VH). Risk refers to the probability and expected severity of tree or stand damage. Some factors contributing to risk include availability of host species, shape and size of cutblock or opening, geographic location, resilience of managed crop species, or amount of light.

Identify any forest health factor estimated to be within the range of threshold values (indicated in the specific forest health factor guidebooks or handbooks) and indicate the appropriate pest survey, if required. Specific pest surveys should be carried out only when necessary (e.g., as outlined in the Forest Practices Code of British Columbia Act).

Note: Use the following Forest Practices Code guidebooks and any regional guidelines to determine the incidence level and management strategies for various pests: Forest Health Surveys, Dwarf Mistletoe Management, Root Disease Management, Defoliator Management, Pine Stem Rust, Management of Terminal Weevils, and Bark Beetle Management. The Field Guide to Pests of Managed Forests in British Columbia, or the Field Guide to Forest Damage in British Columbia, will help to identify the pests.

Comments / special considerations: Indicate whether the forest health factor is present in, or adjacent to, the stratum. If a health factor is identified adjacent to the stratum, record its approximate distance from the proposed cutblock. Some forest health factors (e.g., mountain pine beetle) may pose a risk even if they are located in the general vicinity of the stratum (i.e., area
under a forest development plan). Describe the incidence as continuous or intermittent in nature.

Clarify the distribution of the forest health factors that are currently present. Record the tree layers affected, the number of dead trees, and the observed effect on the host trees.

Assess any forest health factors or hazards that might be expected to occur before the harvest of the next crop (see the *Forest Health Surveys Guidebook*).

*Note:* Always indicate if no significant forest health problems are found during the walk-through, especially for ecosystems designated as a high hazard for certain pests. Refer to the Forest Health Charts in Appendix 6 of the Establishment to Free Growing Guidebook, or tables available in regional ecological field guides.

**SILVICULTURE**

24. LIMITING FACTORS
Assess factors for the stratum that could limit crop tree establishment, survival, and growth. Some regional ecological field guides describe common growth-limiting factors for the various BEC subzone/variants (e.g., Braumandl and Curran 1992). These are also the subjects of the SYTEPREP decision aid (Curran and Johnston 1991). These may include one or several of the following.

**SOILS**

**Cold soils:** Optimum root activity occurs at temperatures close to 20°C. However, northerly latitudes and high-elevation sites will have soils that stay below 10°C well into the growing season. These cold soils will reduce root growth and, therefore, the seedling’s vigour and subsequent growth.

Cool, shaded microsites in cold subzones should be avoided. Burned microsites may increase soil temperatures by reducing the depth of organic matter and blackening the surface. Mounding will greatly improve the soil temperature regime by elevating and exposing mineral soil.

**Shallow soils:** These will hold much less water than deeper soils and therefore tend to dry out. They also limit rooting volume and can be prone to nutrient deficiencies. Shallow soils can be difficult to plant.

**Deep organic layers:** Organic matter is a poor thermal conductor, and organic layers will keep soils colder than if the mineral soil is exposed. However, decomposed organic humus on some wet and warm, highly
productive sites may be the best rooting medium because of the excess moisture below.

Organic matter often contains the bulk of soil nutrients, helps retain moisture and soil porosity, and protects the underlying soil from structural damage and erosion. Surface organic layers also have a high water-holding capacity.

Soil temperature and moisture levels beneath deep forest floors fluctuate less throughout the growing season. This effect may be undesirable for cold climates and aspects because seedling root growth may be inhibited by low soil temperatures during the growing season. However, for warm climates and aspects, the presence of a deep forest floor may help to conserve soil moisture. Well-decomposed organic layers can be an acceptable planting medium, especially on freely drained mounds on very wet sites.

**High % coarse fragments:** Coarse fragments reduce the available water storage capacity of a soil. They can also limit rooting volume. Generally, soil nutrient capital decreases as coarse fragment content increases. Stoney soils can be difficult to plant.

**Wet soils:** Sites with restricted drainage and high water tables can limit tree growth. Oxygen uptake by roots is impaired when water occupies soil air spaces. Saturated soil conditions can also result in lower soil temperatures. Seasonally wet soils, as evidenced by mottling, indicate unacceptable seedling microsites.

If naturally occurring, well-drained hummocks are unavailable, site preparation is likely a consideration. Moisture-tolerant species and some forms of site preparation (e.g., mounding) can help alleviate this problem. Management prescriptions should maintain or improve soil drainage and aeration.

**Nutrient-deficient soils:** Low nutrient levels are unlikely to affect seedling establishment, although they can influence growth over the long term. Calcereous soils (high pH soils, often derived from limestone) are considered to cause nutrient deficiencies in trees if the high pH layer is close to the surface (<30 cm.) Nutrient-deficient trees can also become vulnerable to many other factors (e.g., pests). Nutrient requirements vary by tree species.

Consider where most of the available nutrients and appropriate rooting media are located in the soil profile. Many soils in British Columbia are characterized by a concentration of the soil nutrient capital in the upper soil horizons. Mixing humus materials with the surface mineral horizons may improve the nutrient status for the seedling (use caution where unfavourable substrates may be present).
HEALTH

**Pests:** Insects or diseases can destroy, damage, or reduce growth rates of the new forest crop. For this assessment, examples from older nearby cutblocks can be used. Examples include: Rhizina root rot (primarily in wet areas of the Vancouver, Prince Rupert, and Nelson forest regions, where the site will be slashburned), stem rusts, dwarf mistletoes, plantation weevil, and black army cutworm. Pests often attack trees already stressed by other factors.

Refer to any forest health factor previously identified in the forest health section (**item 23**).

**Root disease:** The presence of root disease will limit the choice of crop tree species for the site and have management implications for all phases of the silvicultural system. Partial-cut harvesting, and commercial thinning, spacing, and brushing treatments must all be cautiously reviewed before being prescribed in the SP.

When evaluating a prescription, all high-hazard and high-risk biogeoclimatic subzones (see appendices in the *Root Disease Management Guidebook*) **shall be considered as infected** at a level exceeding the maximum treatment threshold **unless otherwise stated in the prescription**. The prescription must address these infection levels, even if root disease is absent from the stratum, or present at a lower incidence level. The only exception is when the prescription explicitly indicates the absence of the root disease from the opening or cutblock.

**Wildlife damage:** Wildlife can chew or cut roots, debark main stems or branches, or remove foliage and buds. Tree wounds caused by wildlife can allow disease organisms to enter the tree. Reduced growth rates, lost volume, deformity, and mortality can result.

Most wildlife problems related to tree establishment occur in high-use areas, such as winter ranges, small blocks, and timber edges of large blocks.

Some examples of damage and the wildlife responsible include:

- seed consumption (field mouse, squirrel);
- seedling browse (deer, snowshoe hare, cottontail rabbit, vole, gopher, grouse);
- pole tree stem damage (squirrel, porcupine, bear, vole, sapsucker).

Other small mammals causing damage on a limited scale are the American pika, pocket gopher, and bushy-tailed woodrat. The risk of small mammal damage can increase with vegetative cover, especially in grassy areas and
aspen thickets. Strategies to deal with small mammals include reducing post-harvest slash, planting less-susceptible species, and considering habitat enhancement for predator species (Backhouse and Manning 1996).

Strategies to deal with ungulate problems include planting non-preferred species, using mechanical barriers (Booth and Henigman 1996), and selecting microsites that obstruct feeding (obstacle planting adjacent to slash accumulations or stumps).

Further information on the control of mammal damage can be found in Chapter 22 of *Regenerating British Columbia’s Forests* (Lavender et al. 1990).

**Livestock damage:** Livestock can trample or browse seedlings, or abrade the main stem bark. Consider whether present or future range use in the area might affect seedling performance and growth. Surrounding cutblocks can often provide clues. Communication with the range tenure holder is recommended, particularly when planting or natural regeneration are contemplated.

Note that cattle typically choose the easiest route to travel (e.g., trenches). Obstacle planting (i.e., planting seedlings beside large rocks, slash, stumps) is a recommended treatment for highly grazed areas.

**CLIMATIC**

**Air temperature extremes:** The temperature of the air surrounding the seedling can be limiting at both extremes. Sites can be either too hot or prone to frost. In the former case, tree seedlings can experience stem girdling caused by excessive heat at the soil surface. In subzones with hot dry summers, seedlings are at the greatest risk of heat damage on flat or south-facing slopes. Risk of heat damage will increase with steepness on south slopes. Blackened forest floors will also increase heat loads. Heat loads can be decreased by: favouring shaded microsites; leaving a partially cut overstorey; or planting on the north side of obstructions, such as stumps, large slash, and clumps of vegetation.

**Summer frost:** Sub-lethal or lethal cold temperatures can occur during the growing season. This is more prevalent in the Interior. Summer frosts can occur on a calm, clear night in a dry subzone, or at higher elevations. Sites with surface organic layers and lack of vegetation are more prone to frost damage. The presence or absence of certain plant species can help delineate frost-prone areas. Frost-hardy tree species should be considered. Some forms of site preparation and vegetation management or partial cutting may help alleviate this problem. Stathers (1989) provides a thorough review of summer frost in young forest plantations.
**Frost heaving:** This occurs in wet mineral soils where only a thin layer freezes at the surface. Seedling stems frozen into the soil surface are lifted out of the soil by the formation of vertical ice lenses. This can occur in both the spring and fall and is more prevalent at higher elevations.

Frost heaving shears the fine roots and dries those roots exposed when the seedling is lifted. Heaving occurs more frequently on mechanically prepared sites with moist or wet, silty-textured soils that are planted with plug stock. Removal of the organic layer can also promote frost heaving.

**Snow press / damage:** Damage is caused by snow press, snow creep, or snow glide. Damage also occurs when long-lasting snow shortens the length of the growing season. Risk of snow damage (broken or deformed stems) is greatest where wet, heavy snowpacks undergo considerable settling, or where downslope movement of dense snowpacks occurs (the risk is highest on smooth slopes > 35%).

Snow press is common in high-elevation subzones on the Coast and in wet-belts in the Interior. Species with robust stems and branches, such as amabilis fir, subalpine fir, and spruce, can better withstand snow press.

Snow creep is movement within the snowpack that can damage tree stems. Snow glide is movement of the entire snowpack downhill. To help avoid damage to seedlings from snowpack movements, consider planting on the downslope side of stumps, and among large pieces of slash or large clumps of shrubs.

Lingering snowpacks can cause damage or mortality due to snow mould. To reduce the possibility of snow mould, select or create elevated microsites, or use similar strategies to those mentioned for snow creep.

**Cold-air ponding:** When air cools, it flows downslope and accumulates in level areas and depressions. These areas are at much higher risk of frost during the growing season than mid- and upper slopes. Cold-air ponding can occur both at the local level (valley bottom vs. adjacent slopes) and microsite level (depressions vs. mounds). Cold-air ponding often occurs at the bottom edge of clearcuts where air flow is blocked by the forest canopy. The establishment of frost-resistant species, or the selection or creation of elevated microsites, should be considered.

**Winter desiccation:** This occurs when the plant loses water to evaporation because it cannot translocate water from frozen soil, roots, or xylem. The injury is common on southern slopes where sun-exposed leaves and stems can rise above 15°C while soil temperatures remain below 0°C. Winds can contribute to desiccation of exposed foliage, especially on exposed droughty sites or in chinook-prone areas.
**Wind:** Areas prone to high winds (e.g., exposed mountaintops, along seashores or large lakes, converging valleys) experience increased plant evaporation and transpiration losses. Soil indicators in windy areas include weak soil profile development due to scalped (eroded) profiles, evidence of soil erosion on the windward side, soil deposition on the lee side of hills or road cuts/fills, and the presence of dunes. Vegetation indicators include strongly reduced height growth and gnarled growth form with tree tops and branches oriented downwind (Luttmerding et al. 1990). If moisture is already limited, desiccation by wind can be severe or lethal for seedlings. Wind can also cause mechanical damage.

**Growing-season length:** This is greatly affected by elevation and latitude. Northern latitudes and high-elevation sites generally have a short growing season because of either deep snow accumulations, which persist into the summer, or extreme climatic conditions.

**Moisture deficit / drought:** This occurs during a significant portion of the growing season on dry sites with coarse, well-drained soils. Drought also occurs where grass cover or other aggressive vegetation is dense. On water-deficient sites, planting close to well-decomposed wood may improve water availability for seedlings. The following landforms also contribute to drought: knolls, ridges, steep southern aspects, talus slopes, coarse-textured glaciofluvial terraces, sand dunes, shallow soils, and coarse-textured soils underlain by porous bedrock (e.g., sandstone and other sedimentary rock).

Exposed mineral soil on dry sites can lose moisture rapidly during the summer; this is particularly true for silty-textured soils, which conduct moisture to the evaporating surface through capillary action. Decomposed organic matter which is incorporated into the mineral layers, helps to hold soil moisture. Drought-tolerant species or some forms of site preparation may alleviate this problem. In hot subzones or variants, partial-cutting systems provide overhead shelter and reduce drought stress for certain species such as Douglas-fir, particularly on south-facing slopes. In clearcuts, microsites shaded by stumps, slash, or artificial shading devices may reduce transpirational losses to the seedlings.

**Vegetation (light):** Sites with aggressive vegetation, such as salmonberry, thimbleberry, fireweed, bracken fern, red alder, cottonwood, and aspen, limit light available to establishing crop trees. Low light levels significantly reduce net photosynthesis and, consequently, heavily shaded seedlings accumulate little biomass, grow slowly, and have a spindly growth form. This is often a serious problem in many of the wetter subzones in British Columbia.
Vegetation (press): Herbaceous species, such as fireweed, ferns, or grass, can subject establishing crop trees to pressure from the weight of their dying foliage and stems during the fall and winter months. This press often deforms the main stem of seedlings and increases snow mould problems.

Vegetation (moisture/nutrient): Competing non-crop species can limit nutrients and moisture availability for seedlings on certain sites. Remember that nutrients are not lost from the system, but are taken up, stored, and recycled by the vegetation. The net effect may be positive for long-term site productivity. On dry sites, avoid microsites with dense grass or other aggressive vegetation.

Consider also the beneficial effects that non-crop species may have on seedlings by providing shade and thermal protection from frost, and by adding soil nitrogen. In hot, arid areas, growth and survival are improved by leaving shade for seedlings, which reduces heat stress (and increases humidity).

Understanding all the limiting factors on the site is critical to the final decision for vegetation control.

The presence of vegetation-limiting factors can be mitigated by the use of appropriate silvicultural systems, pre-harvest vegetation control, site preparation, prompt planting with healthy, vigorous seedlings, or rapid brushing and weeding to prevent the seedlings from becoming weakened by overtopping brush.

Specific information on the autecology of 35 common British Columbia plants and their response to management treatments can be found in Coates et al. (1990) and Haeussler et al. (1990).

Heavy slash: Slash, if considerable, can be an impediment to regeneration. The composition (i.e., health and age) of the existing stand will often provide clues about the expected slash loading after harvest. Consider also existing dead forest fuels and cedar volumes.

EXPLAIN AND COMMENT

Several blank lines on the stratum card are provided for the surveyor to record other limiting factors. Extra space is also available to explain and comment on any of the identified limiting factors.

When all limiting factors are identified, refer to the regional ecosystem field guide and the *Establishment to Free Growing Guidebook* applicable to your forest region and select the most appropriate tree species to establish the new crop. Each tree species is tolerant of several environmental and health
factors. Matching the correct species for a particular situation can often overcome the limiting factor(s).

25. TREE ESTABLISHMENT
Indicate whether the free-growing stand will be established by natural means or by planting. The historical regeneration pattern for the area may indicate that a combination of the two is acceptable.

Indicate whether saplings (advanced regeneration) are going to contribute to the free-growing stand and describe the acceptability criteria required to meet a free-growing tree (as assessed by the surveyor, not reiterated from free-growing standards).

Natural: If reforestation is to be accomplished by natural regeneration, consider and discuss the following factors: cone distribution, seed trees, adjacent seed source, acceptable seedbed (i.e., consider forest floor depth, mineral soil exposure), seed dispersal, acceptable saplings, species providing the seed source (e.g., will they be acceptable?), pathogens (existing or potential), and windthrow hazard to seed trees.

Plant: Planting provides the opportunity to control species composition, regeneration timing, and the seed source of a future stand. To achieve high rates of seedling survival and growth performance, a careful assessment of limiting factors must be made.

If reforestation is to be accomplished by planting, consider species based on the regional ecosystem field guide. In some situations, species other than the “preferred” may be selected. When this occurs, include the rationale for the selection. If a species mix is to be used, indicate how it should be planted spatially. Also, note suitable stock type(s), any specific microsite criteria, and season of planting (spring, summer, fall).

For further information, refer to the Provincial Seedling Stock Type Selection and Ordering Guidelines (Scagel et al. 1993). Further comments might include whether the recommended stocking standard is reasonable, given site limiting factors and the chosen methods of harvesting, site preparation, and tree establishment.

Combination: If a combination of planting and natural regeneration is to be relied on for tree establishment, then indicate the percent contribution by each, or discuss the specific areas to which each apply.

26. SITE PREPARATION
After careful consideration of species and stock type choices, indicate whether site preparation will be necessary after harvest, and outline the
limiting factors to be mitigated. Recommend the method(s) of site preparation you feel will best address the most serious limiting factor. Indicate any constraints (i.e., site, seasonal, or timing) to the chosen method(s) of site preparation. Consider also whether site preparation will affect other identified resource values. Site preparation should create enough disturbance to overcome the limiting factors without causing excessive soil disturbance.

Site preparation can achieve any of the following:

- reduce vegetative competition
- decrease risk of frost damage
- overcome moisture problems, such as desiccation or waterlogging
- increase the temperature in the root zone
- increase available oxygen in the soil
- reduce risk of insect attack
- reduce hazard from fire
- facilitate planter access
- increase nutrient availability

For information about site preparation, refer to the *Site Preparation Guidebook*.

If prescribed fire is being considered, then provide an assessment of the sensitivity to prescribed fire using keys available in some regional ecosystem field guides or the method presented in the *Fire Management Guidebook*.

**STAND TENDING**

27. VEGETATION COMPETITION (BRUSHING)
Based on information collected on plots within the stratum (i.e., item 22, FS 39A), indicate whether brushing can be anticipated. Note that proper site preparation, in the first place, is often the most cost-effective way to deal with competing vegetation. Provide details of the species to likely require control and the treatment method(s) (e.g., manual, chemical, grazing), and assess the constraints to the brushing treatment (e.g., topography, chemical use restrictions, soils). Indicate the optimum treatment window and possible timing after harvest.

A discussion of the control of competing vegetation can be found in Chapter 19 of *Regenerating British Columbia’s Forests* (Lavender et al. 1990).

28. SPACING / PRUNING / FERTILIZATION

**Spacing:** When spacing is anticipated for stocking control or to meet other resource objectives, indicate the method and the approximate timing. Indicate important considerations, such as the intended stand composition
and post-spacing density, and the anticipated effects on wildlife habitat or domestic grazing opportunities.

**Pruning**: When pruning is required to manage white pine, meet wildlife habitat objectives, or otherwise achieve free-growing requirements, indicate the approximate timing. Indicate important considerations, such as target species, recommended knot size (if applicable), required crown retention, and forest health.

**Fertilization**: When fertilization is required to meet long-term timber supply objectives, or is considered advantageous to achieve a healthy free-growing stand, indicate the method (ground or aerial) and the approximate timing. Indicate target species for treatment, and whether or not screening trials are recommended.

For further coverage on the topics of pruning and fertilization, refer to the *Pruning Guidebook* and the *Forest Fertilization Guidebook*.

For all of the above, discuss any constraints to the recommended treatment(s).

**RESOURCE VALUES / CONCERNS**

Many of the other resource values will be identified before conducting the field assessment. However, data collected using the stratum card (FS 39B) ensure that concerns identified at higher levels of planning continue to be carried through to the operational phase. The surveyor(s) must assess all existing planning and resource information so that any concerns can be addressed and verified in the field. Consider resource values both in, and adjacent to, the stratum.

29. **PLANT DIVERSITY**

Describe the attributes of the existing plant community. These attributes may include wildlife trees (Figure 32), coarse woody debris, standing dead trees, large living trees, and special vegetative habitats.

- **Coarse woody debris (CWD)** – Decaying logs on the forest floor provide cover, microclimates, and breeding habitat for a variety of organisms. These organisms include vertebrates, fungi, invertebrates, lichens, plants, and micro-organisms. Woody debris should be retained in the stand, within utilization standards. Larger-sized pieces are preferable, as they provide the greatest longevity and potential for nutrient cycling and wildlife use in the second-growth forests. Coarse woody debris is rarely evenly distributed, but it should be as well distributed as possible throughout the block. In drier ecosystems, much of the forest floor is
**Figure 32.** British Columbia’s wildlife tree classification system (Fenger and Chatwin 1995).

<table>
<thead>
<tr>
<th>Decay class</th>
<th>LIVE</th>
<th>DEAD</th>
<th>DEAD FALLEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Live/healthy no decay; tree has valuable habitat characteristics such as large, clustered or gnarled branches or horizontal, thickly moss-covered branches.*</td>
<td>Dead needles and twigs present; roots healthy.</td>
<td>Dead extensive internal decay; outer shell may be hard; lateral roots completely decomposed; hollow or nearly hollow shells.</td>
</tr>
<tr>
<td>2</td>
<td>Live/unhealthy internal decay or growth deformities (including insect damage, broken tops); dying tree.*</td>
<td>Dead most branches/bark absent; some internal decay; roots of larger trees stable.</td>
<td>Debris downed trees or stumps.</td>
</tr>
<tr>
<td>3</td>
<td>Nesting (e.g., bald eagle, great blue heron colonies, marbled murrelet); feeding; roosting; perching.</td>
<td>Dead no branches or bark; sapwood/heartwood sloughing from upper bole; decay more advanced; lateral roots of larger ones softening; smaller ones unstable.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Nesting/roosting - strong PCES; (woodpeckers); SCUs; large-limb and platform nests (ospreys); insect feeders.</td>
<td>Dead no branches or bark; sapwood/heartwood sloughing from upper bole; decay more advanced; lateral roots of larger ones softening; smaller ones unstable.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nesting/roosting - weak PCES; SCUs; insect feeders.</td>
<td>Insect feeders; salamanders; small mammals; hunting perches; occasionally used by weak cavity excavators such as chickadees.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Nesting/roosting - weak PCES; SCUs; insect feeders.</td>
<td>Weaker PCES; SCUs; insect feeders; salamanders; small mammals; hunting perches.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Nesting/roosting - weak PCES; SCUs; insect feeders.</td>
<td>Insect feeders; salamanders; small mammals; hunting perches; occasionally used by weak cavity excavators such as chickadees.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>approx. 2/3 original height</td>
<td>approx. 1/2 original height</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>approx. 1/3 original height</td>
<td>approx. 1/3 original height</td>
<td></td>
</tr>
</tbody>
</table>

1. Large witches’ brooms provide nesting/denning habitat for some species (e.g., fisher, squirrel).
2. PCE = primary-cavity excavator
3. SCU = secondary-cavity user
* This classification system does not recognize root disease trees specifically. Such trees become unstable at or before death.
derived from CWD, which needs to be maintained on-site. Will enough be left? How will new CWD be recruited during the rotation?

- **Standing dead trees** – Standing dead trees provide nesting and foraging habitat for a wide range of species. Providing wildlife trees in managed forests is probably the most important stand management practice for maintaining above-ground biodiversity. Some existing wildlife trees should be retained, but equally important is the recruitment of wildlife trees into the stand. Small-diameter wildlife trees are adequate for some species, but large-diameter wildlife trees are required by other species, and they endure longer (see *Landscape Unit Planning Guide*, “Wildlife Tree Retention”).

Techniques to maintain an adequate number of wildlife trees and provide future wildlife trees in managed stands include:

- Retaining some wildlife trees during harvesting, where it is safe to do so (within wildlife tree reserve areas and along block boundaries).
- Retaining some live trees during harvesting as a source of large-diameter wildlife trees in the subsequent rotation.
- Promoting a deciduous component in the stand as a source of wildlife trees.
- Retaining wildlife trees during spacing and thinning (where it is safe to do so).
- Creating wildlife trees.

- **Large living trees** – Large, old, living trees provide several unique habitat attributes and should be retained. For example, large mossy limbs provide marbled murrelet nest sites and habitat for numerous invertebrate species. Arboreal lichens and other epiphytes are most abundant in older trees. Large living trees also provide a source of future wildlife trees.

Such trees can be retained through a variety of silvicultural systems and harvesting activities. Wildlife tree patches established to maintain snags are also good areas for retaining large living trees.

**Note:** Do not retain or create wildlife trees close to permanent access routes where they may fall, or be cut for firewood.

**SAFETY FIRST**
Safe work practices must always be the first consideration in any wildlife tree management prescription. Single-stem safety assessment procedures are contained in the *Wildlife/Danger Tree Assessor’s Course Workbook*. Further details are also provided in the *Partial-cutting Safety Handbook* (B.C. Ministry of Forests 1996).
Special vegetative habitats – Patches of deciduous trees, willow thickets, and meadows are all examples of special habitats. These should be identified as separate strata, if large enough, or excluded from harvesting or silvicultural operations.

Maintaining tree species diversity, along with structural diversity, is also a necessary consideration in managing for plant diversity. Discuss how these attributes will be maintained, or how they will be restored.

• **Tree species diversity** – An ecologically appropriate variety of tree species, including hardwoods, should be retained in a stand. Such diversity can meet the habitat requirements for a greater variety of organisms than could be met in a homogeneous stand. Tree species composition can be managed through the silvicultural system by choice of harvesting, site preparation, planting, regeneration, and stand-tending activities.

• **Structural diversity** – A variety of canopy layers (vertical structure) and spatial patchiness (horizontal structure) are important attributes for maintaining biological diversity. This variety of layers includes the naturally occurring forest understorey of shrubs and forbs, which provide food and cover for numerous species. To maintain understorey vegetation, a partially open or patchy forest canopy is required. Structural variety creates more habitat and microclimate diversity than homogeneous stands.

Vertical and horizontal structural diversity can be maintained or created through the silvicultural system by choosing appropriate harvesting methods, stocking levels, and stand-tending activities. Even-aged systems tend to create structural variety between stands that are at different seral stages, whereas uneven-aged systems tend to create structural variation within single stands. With either method, structural variety changes as forests grow.

To maintain desired stand-level characteristics into the future, it is important to work with the attributes already present in each stand. High-value habitat features (e.g., large live trees, or large snags along riparian area) should be identified, and retained where it is safe to do so. Consult the Ministry of Environment, Lands and Parks published lists of rare plant associations to determine whether any are present within the stratum. Further information on stand-level management practices to maintain biodiversity can be found in the Landscape Unit Planning Guide.

30. **Faunal Diversity**
Assess and record the existence of fauna and their habitat from evidence found within, or adjacent to, the stratum. Note the presence of tracks,
burrows, nests, dens, runways in the grass, feeding sign, game trails, artifacts (e.g., feathers, hair, shed skins, cast antlers), droppings, etc. Assess the abundance of attributes (raptor nests, occupied snags, arboreal lichens, winter range) that may be of particular importance to fauna.

Identify all faunal species present (e.g., ungulates, amphibians, reptiles, game and non-game birds, and small mammals). If possible, determine whether habitat is critical for rare or endangered species. Consult the Identified Wildlife Management Strategy for specific measures to address these species.

Also, assess the effect that timber harvesting will have on the identified values.

31. FIRST NATIONS / TRADITIONAL USE / CULTURAL HERITAGE
Note any evidence of undocumented artifacts, features, or sites found within, or adjacent to, the stratum. Artifacts are objects; features are structures, such as hearths, houses, and storage pits; sites can include (but are not limited to) kill sites, habitation sites, and burial sites.

The following clues outline what to look for (these may vary between the Coast and Interior).

• Shallow concave depressions with a circular or nearly circular circumference. These depressions are often grass covered from past ground disturbance, but can have trees growing within them (i.e., plant succession since occupation). These depressions could be house pits or cache pits. House pits (i.e., lodgings) were generally located near winter camp sites and were usually one terrace up from a water body. Cache pits, used for storing foods, are much smaller than house pits, and usually several are found in the proximity of a winter camp site.
• Rocks piled together on a slope may be evidence of an old deer blind used for eluding deer when hunting.
• Petroglyphs (carvings) etched into rock.
• Pictographs (drawings or paintings) on rock, usually of red, black, yellow, white, or green colours. Red is the most common colour, with black the next most common. Pictographs are usually found on rocks that could not normally be moved. Often, two small rocks were placed on top of the pictograph rock. If they are no longer present, you may see two small depressions where they once were located. More information on this subject can be found in Corner (1968).
• The following might be evidence of culturally modified trees: horizontal lines around a tree where bark was stripped when deer were hung between two nearby trees; a cat face on a pine tree where sap was extracted for eating; a blaze (often at breast height) to mark a trail (these blazes will often be located along the same side of the trail).
• Old Douglas-fir leading stands (i.e., age class 9) were often used to collect lichen for making candy and needle gathering to extract sugars. These areas would be considered as traditional use areas.

• Areas used for hunting and gathering plants for food and traditional use.

Note: Be aware that many First Nations leaders have concerns about operational plan maps showing the location of artifacts and features found in the area. Before preparing the SP, contact the Ministry of Forests district office to find out what policies are in place regarding how these resources must be accommodated. Also determine whether or not (or how) these resources should be referenced in the SP (or other operational plans).

For further information on this topic, refer to Section 2.1 of this handbook.

32. LANDSCAPE / RECREATION
Assess the existing recreation feature(s), if any, in the stratum. The visual landscape and recreation resources noted within, and near, a cutblock or opening must be described on the basis of definitions and procedures provided in the Ministry of Forests Recreation Manual and the Visual Impact Assessment Guidebook.

If there is a question about an assessment, consult the Resource Officer (Recreation) in the district office. For further information on this topic, refer to Section 2.1 of this handbook.

33. OTHER
Indicate whether there is any evidence of unidentified resource values. This could include water improvements, artificial structures, rare plants or plant communities, animal traps, mining claim tags, and evidence of use (e.g., horse trails, trail blazes, botanical product picking) by any particular groups or individuals.

34. RANGE
If there are no existing range agreements or range developments within, or adjacent to, the stratum or cutblock, this section can be recorded as not applicable. Otherwise, assess the existing range values and consider the value of grass seeding.

Determine whether the site is a permanent range ecosystem (i.e., it provides substantial herbaceous forage throughout most or all successional sequences). Sources of information for this assessment may include ecosystem mapping, district mapping of permanent range, district range staff, ecosystem descriptions in the regional ecosystem field guides, and characteristics of the site (e.g., herbaceous forage, soil classification, Ah horizons, mull humus
forms). Consider the effects of forest treatment selection on permanent range. Historic range values would have been generally high in naturally open, generally uneven-aged forest stands. Maintaining this type of stand structure is recommended for permanent range ecosystems.

In the field, note the level of grazing use (forage removal), and estimate the effects livestock will have on regeneration establishment and survival (see also item 24). Adjacent areas can provide helpful clues to the effects of grazing on regeneration.

Consider whether the harvesting of the proposed cutblock will breach an historic natural barrier to cattle movement. Cattle management and regeneration problems may result if cattle movements are not otherwise controlled. The Forest Practices Code requires that anyone who removes or renders ineffective a natural range barrier must take measures specified by the district manager to mitigate the effects of such activities.

**Grass seeding:** Assess whether grass seeding would be acceptable. If so, indicate specifically where (landings, roadside, whole cutblock, etc.) to seed grasses. Be sure to consider the effect of grass seeding on seedling establishment.

Seeding grasses can minimize erosion and weed infestation, enhance the nutrient supply on a site through nitrogen additions (where clover is in the mix), improve soil structure, and provide forage for livestock. If sites are prescribed for seeding, they should be seeded immediately after disturbance. The longer the delay, the greater the potential for soil erosion, site degradation, cementing of soils, and growth of undesirable vegetation, including noxious weeds. The use of native seed is suggested in the *Biodiversity Guidebook*; also check the *Landscape Unit Planning Guide*. Weigh these considerations carefully against your chosen method of regeneration.

For information about range, refer to the *Ministry of Forests Range Manual*, and the *Range Management Guidebook*.

### 4 SUMMARY

Preparation of a silviculture prescription as required under the *Silviculture Practices Regulation* relies heavily on the ability of the surveyor to collect and assimilate field data. This handbook provides a framework for collecting technically accurate, meaningful information. As with all guides, it must be used with discretion so that the type of data collected, and the level of detail provided, are appropriate to the user’s needs.