Forest Practices Technical Note Number 2

High Landslide Hazard Locations, Shallow, Rapidly Moving Landslides and Public Safety: Screening and Practices

Version 3.0
Effective December 10, 2024

Objective

Technical notes are written to highlight current issues related to protecting and managing forestland resources and are tied to various aspects of the Oregon Forest Practices Act (FPA). This technical note is designed to help forest practices foresters, landowners, and operators screen forestlands prior to harvesting (or other activities including thinning and pre-harvest hack and squirt), road construction or road reconstruction to identify locations subject to the Shallow, Rapidly Moving Landslides and Public Safety Rules (OAR 629-623-0000 through 0800). For operations identified by this screening process, *Forest Practices Technical Note 6: Determination of Rapidly Moving Landslide Impact Rating* may be used by a geotechnical professional to determine public safety restrictions.

Background

Senate Bill 12 (1999) directed the Board of Forestry to adopt rules to replace a temporary prohibition of certain operations authorized by Senate Bill 1211 in 1997. The Shallow, Rapidly Moving Landslides and Public Safety rules became effective January 1, 2003, and at that time Version 2.0 of this note replaced Version 1.0 (from October 18, 2000). The present Version 3.0 was written to clarify the screening and review process for landowners and operators with steep slopes, or high landslide hazard locations in their operations. This guidance is intended to apply to shallow, rapidly moving landslides, and should be used with caution when evaluating the public safety risk associated with road fill failures, waste area failures, or deep-seated landslides as processes of initiation and movement may be different.

Terminology

A ***debris fan*** is a deposit formed as an open-slope debris flow or debris torrent comes to rest. Debris fans are typically located at the mouths of canyons or anywhere else channels lose confinement. They can also be located at the base of steep slopes. Debris fans typically consist of unsorted deposits of fines, sand, and gravel, as well as boulders and wood debris.

Exposure categories [629-600-0100] are used to designate the likelihood of persons being present in structures or on public roads during periods when shallow, rapidly moving landslides may occur.

A ***further review area [629-600-0100]*** means an area of land that may be subject to rapidly moving landslides as mapped by the State Department of Geology and Mineral Industries or as otherwise determined by the State Forester.

A ***Geotechnical Specialist*** is an Oregon registered Professional Engineer (PE) or a Certified Engineering Geologist (CEG).

Headwall [629-600-0100] means steep, concave slopes that can concentrate subsurface water, which can lead to increased landslide susceptibility. Headwalls are typically located at the head of stream channels, draws, or swales. Headwalls have slope gradients of 65 percent or greater in the Tyee Core Area and 70 percent or greater in the rest of the state, as measured in the axis of the headwall. Landslides that occur in headwalls are more likely to initiate channelized debris flows that can travel down streams (also known as debris torrents) than landslides that occur in other areas of the slope.

A ***high landslide hazard location [629-600-0100]*** means a specific site that is subject to initiation of a shallow, rapidly moving landslide. The following criteria shall be used to identify high landslide hazard locations:

(a) The presence, as measured on site, of any slope in Western Oregon (excluding competent rock outcrops) steeper than 80 percent, except in the Tyee Core Area (defined below and shown in Figure 1), where it is any slope steeper than 75 percent;

(b) The presence, as measured on site, of any headwall or draw in Western Oregon steeper than 70 percent, except in the Tyee Core Area, where it is any headwall or draw steeper than 65 percent; or

(c) Notwithstanding the slopes specified in (a) or (b) above, field identification of atypical conditions by a Geotechnical Specialist may be used to develop site specific slope steepness thresholds for any part of the state where the hazard is equivalent to (a) or (b) above. The final determination of equivalent hazard shall be made by the State Forester.

A ***shallow, rapidly moving landslide [629-600-0100]*** means any detached mass of soil, rock, or debris that begins as a relatively small landslide on steep slopes and grows to a sufficient size to cause damage as it moves down a slope or stream channel at a velocity difficult for people to outrun or escape.[1] For the context of this technical note there are two types of these landslides: open-slope debris flows and debris torrents.

> An ***open-slope debris flow*** is a slide that does not enter a confined channel or narrow draw. They occur on open topography such as Uniform Slopes or Ridge-forms. They travel tens to hundreds of feet from the initiating high landslide hazard location and typically deposit on gentler lower slopes or at the base of consistently steep slopes.

[1] Other sources may use the terms Debris Avalanche and Debris Flow referring to mass movements which are fragmented or slurry-like, respectively, regardless of confining conditions. Also, OAR 629-600-0100(30) defines Debris Flow differently than this Technical Note to refer only to confined mass movements which deliver to certain stream types, using the definition to develop a modeled mapping exercise to delimit Debris Flow Traversal Areas [OAR 629-0600-0100(33)]. Division 623 and associated Technical Notes 2 and 6, will define mass movements for use in administration of the Landsides and Public Safety context.

A ***debris torrent*** is a debris flow which becomes confined within a channel or narrow draw, often combining with the streamflow present. They often scour the channel to bedrock, increasing in size as they travel hundreds or thousands of feet beyond the site of initial failure, delivering significant volumes of material to their deposition area. They may exhibit laminar or turbulent flow, their content ranging from mostly solids to mostly water.

Tyee Core Area [629-600-0100] means a location with geologic conditions including thick sandstone beds with few fractures. These sandstones weather rapidly and concentrate water in shallow soils creating a higher shallow, rapidly moving landslide hazard. The Tyee Core Area is located within coastal watersheds from the Siuslaw watershed south to and including the Coquille watershed, and that portion of the Umpqua watershed north of Highway 42 and west of Interstate 5. Within these boundaries (as shown in Figure 1), locations where the bedrock is highly fractured or not of sedimentary origin, as determined in the field by a Geotechnical Specialist, are not subject to the Tyee Core Area slope steepness thresholds.

Uniform Slopes and Ridge-forms are defined as slopes where contours are relatively straight, or convex, such that water flowing in the subsoils is not being concentrated from surrounding areas above as it moves down slope.

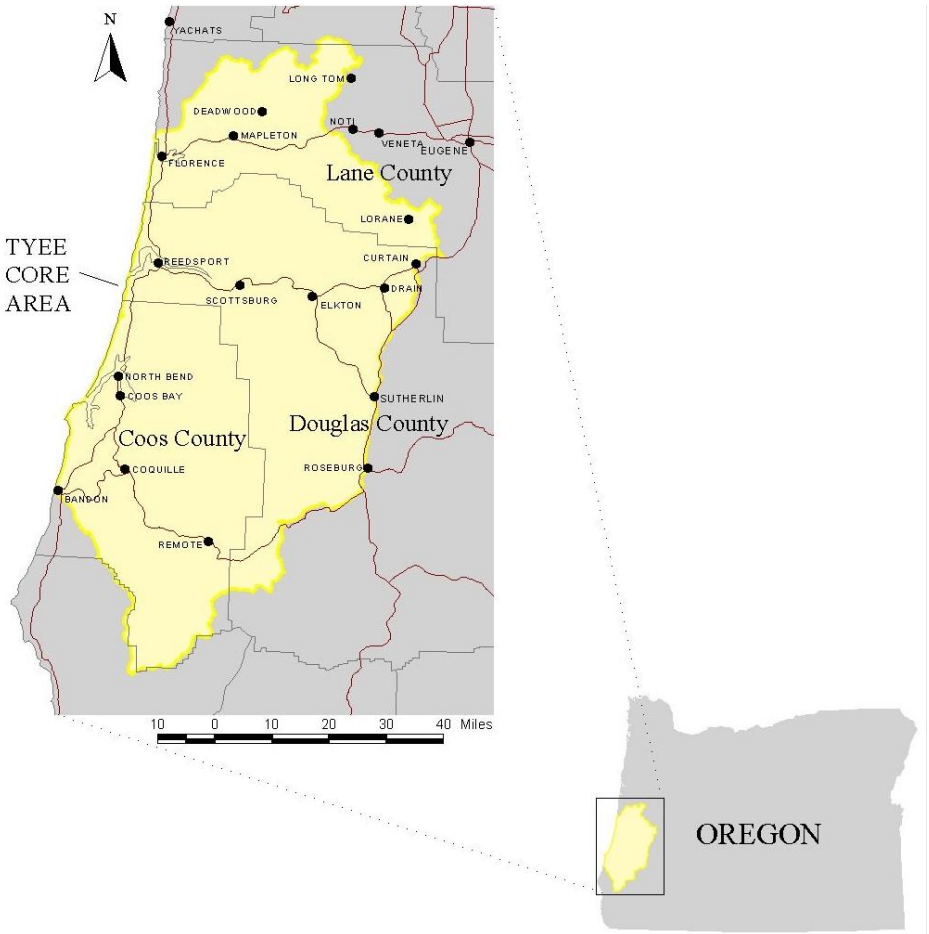


Figure 1. Location of the Tyee Core Area. A GIS feature class of the core area may be obtained from the Department at https://oregon-department-of-forestry-geo.hub.arcgis.com/datasets/6c05493185d54b0f98f2918fe579e363_1/explore.

Overview

After a notification of operation is submitted by a landowner representative, an initial screening of operations will be conducted by the Oregon Department of Forestry (Department) to find steep slopes (high landslide hazard locations) below which public safety concerns could exist. Operators are encouraged to conduct their own public safety screening [OAR 629-623-0100(1)]. If the initial screening shows these slopes are likely, then a formal further review area (FRA) determination needs to be made by the operator and verified by the Department for the individual slopes or drainages in question. Additional information may be requested from the operator by the Department to make the final FRA determination. If the FRA determination finds structures or public roads are present within the FRA, then this information will be used to determine the exposure category for each structure or road and a Geotechnical Specialist will determine the impact rating for each slope and structure or road (see *Forest Practices Technical Note 6, Determination of the Rapidly Moving Landslides Impact Rating*). Once the impact rating is determined, the public safety risk can be evaluated for each HLHL, and proper harvest modifications can be applied as needed. Each of these steps is detailed below in this Technical Note.

Initial Screening of Operations

The initial screen determines if there may be high landslide hazard locations (HLHLs) within the operation area **and** if there may be structures or roads in the path of a potential shallow, rapidly moving landslide below or within the operation area (Figure 2). This initial screen is not a determination of the further review area (FRA), but an abbreviated, coarser look at the possible hazards and public exposure to the proposed operation.

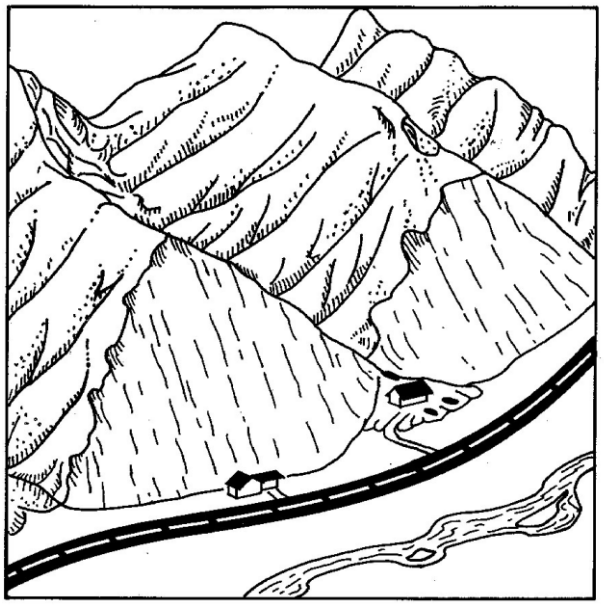


Figure 2. Typical conditions that should be identified by the initial screening process including homes and roads in open-slope debris flow and debris torrent-prone locations (at the base of a uniform steep slope and on a debris fan at the base of a debris torrent prone channel).

The Oregon Department of Forestry will conduct the initial screen to determine if the shallow, rapidly moving landslides and public safety rules (OAR 629-623-0000 through 0800) might apply to an operation. Operators are also encouraged to acquire maps and other information to conduct their own public safety screening (OAR 629-623-0100). The results of the initial screen determine if further investigation is needed. Further investigation is needed (see pages 6-13 of this document) if the initial screen determines that both of the following conditions exist:

1. There may be **high landslide hazard locations** (HLHL's) within the proposed operation area, based on Lidar determined slope steepness or other information AND
2. There may be **structures or public roads** downslope from or within the proposed operation area that could be impacted by a shallow, rapidly moving landslide initiating within the operation area.

Determining HLHLs and slope steepness

The initial screen for slope steepness should use Lidar-based topographic data wherever it is available for the operation. Data can be obtained from DOGAMI at: https://www.oregon.gov/dogami/lidar/Pages/index.aspx. Screening for slope steepness should be done using products generated from the 1-meter Lidar data such as DEMs, hillshades, slopeshades, slope maps, contour maps, etc. The DOGAMI web-based Lidar Viewer found on the above website is for locating and obtaining datasets and is not at the proper resolution to perform the slope screen.

Using data generated through old technologies such as USGS 1:24,000 topographic maps, or the 10- or 30-meter digital elevation models (DEM) based on these maps, are no longer considered good representations of the ground surface for the scale of the operational unit that operators and FPA foresters are concerned with. If Lidar data is unavailable for the operation, the steepest portions of the operation should be visited and measured in the field for the presence of HLHLs. In those cases, DEM's with the highest resolution available for the area could be used to find the steepest part of an operation which could then be visited in the field to determine the actual steepness and if it qualifies as HLHL.

For conducting the slope steepness screen, use slope steepness thresholds for HLHLs in the area of operations as defined in the terminology section of this document and outlined in the table, below.

Table 1.

High Landslide Hazard Location Criteria		
	W. Oregon	***Tyee Core Area***
A. Uniform Slopes/Ridge-forms	**>=80%**	**>=75%**
B. Headwalls/draws	**>=70%**	**>=65%**
AND > 30 feet long (slope distance)		
C. As indicated by a Geotechnical Specialist		

Screening for structures and public roads
When screening for structures and public roads foresters should keep in mind that shallow, rapidly moving landslides move down steep hillslopes and stream channels. They can move long distances, over a mile in some cases, especially if they enter a confined stream channel. If there may be structures or public roads in canyons, near the mouths of canyons, or close to the base of steep slopes below or within the operation, AND if the slope screen (part 1 above) has shown the presence of, or likely presence of, HLHL then additional investigation is needed to determine if structures or public roads reside within an FRA (see step 1 below). The formal FRA investigation will help determine public safety concerns below the slopes likely to have the HLHLs.

Five steps to identify locations subject to the Shallow, Rapidly Moving Landslides and Public Safety rules

STEP 1. DETERMINING THE FURTHER REVIEW AREA

Upon notification by the State Forester, operators shall identify portions of the operation that contain HLHLs and shall also identify structures and paved public roads within further review areas (FRAs) within or below the operation (OAR 629-623-0100). FRAs need to be determined below *each* hillslope or drainage containing HLHLs. In situations where it has been determined that no structures or public roads lie within an FRA below steep slopes, no confirmation of upslope HLHLs is needed.

Part A - Identifying High Landslide Hazard Locations

Are there any high landslide hazard locations present within the proposed harvest unit or along the proposed road [OAR 629-623-0100(1)]?

A high landslide hazard location is a slope with characteristics (steepness, shape, and geology) that make it subject to shallow, rapidly moving landslides. Other landslides that are large and typically move more slowly, such as slumps, deep-seated landslides, and earthflows, are **not** shallow, rapidly moving landslides. A shallow, rapidly moving landslide begins as a relatively small landslide and moves at a velocity that is difficult for people to outrun or escape. Note that HLHL identification is based on physical slope characteristics and is independent of proposed harvesting or road building practices. High landslide hazard locations are further defined in the terminology section of this technical note and summarized in table 1, above.

Field Measurements
High landslide hazard locations may be determined from Lidar and can be confirmed via field measurements especially where Lidar resolution is of lower quality. These field measurements may find slope conditions different from the initial screen and take precedence over the screen. Short pitches of steep slopes that are less than 30 feet slope length are not considered HLHLs. Constructed cutslopes are not considered HLHLs, but sidecast and other fillslopes are. Remember that clinometers do not give precise slope readings, so when slopes just under threshold criteria are measured with a clinometer, they may in fact be HLHLs. Often, reversing the reading will provide confirmation.

Atypical Conditions
The definition of HLHL from the terminology section assumes homogenous geologic and subsurface conditions. Section (c) of the definition recognizes that there are site-specific characteristics, which may give a Geotechnical Specialist reason to modify the slope thresholds in sections (a) or (b). For example, slope thresholds might be adjusted to be steeper on a site in the Cascade Range with a well-drained talus slope. Conversely, evidence of slope instability, such as actively failing slopes, may justify the decision to lower the slope thresholds. There are several factors which may influence initiation hazard such as soil depth, soil material properties, slope-shape, vegetative characteristics, bedrock characteristics, subsurface water flow, and others. A Geotechnical Specialist will have to present supporting evidence to demonstrate that modification of the standard slope thresholds is appropriate for the specific site.

Part B - Identifying extent of the Further Review Area
Does the channel or slope have characteristics which are conducive to open-slope debris flow or debris torrent transport or deposition?

Debris torrents and open-slope debris flows are two types of shallow, rapidly moving landslides defined in the terminology section of this technical note. Debris torrents usually stop when they enter unconfined channels, low gradient stretches of channels, or debris fans. Open-slope debris flows typically slow down or stop when they encounter unconfined and relatively gentle slopes (wide valleys or benches).

For debris torrents, the further review area (FRA) starts at the HLHL and is 100 feet (measured horizontally, not with slope distance) on each side of a confined channel. The FRA ends after any of the following conditions are encountered:

1. The average channel gradient becomes 6% or less for at least 300 feet.
2. The canyon width exceeds 200 feet or more for a distance of at least 300 feet. The width is generally measured at a height of 10 feet above the channel bottom.
3. The channel loses confinement (such as at the mouth of a canyon). The further review area extends 200 feet from the point where the channel loses confinement.

Two other FRA criteria exist including:

4. For open-slope debris flows, the FRA starts at the HLHL and ends 100 feet downslope after the slope gradient drops to and remains below 40%.
5. Regardless of the conditions described above, if there is field evidence of a debris fan at the mouth of the channel or base of a slope, the FRA continues to the lower edge of the debris fan.

Refer to Appendix A for examples of each of the five FRA determinations.

STEP 2: DETERMINING THE EXPOSURE CATEGORY OF STRUCTURES OR PUBLIC ROADS IN THE FURTHER REVIEW AREA

When there are HLHLs within a proposed operation, operators must identify structures and public roads that might be at risk from rapidly moving landslides initiating within the operation area [OAR 629-623-0100(2)]. Operators should carefully look for structures or roads on the ground and with other available information such as satellite imagery or county / state records[2]. Permission should be obtained from other landowners as needed. If structures or public roads are within the FRA, determine the Exposure Category of each for the operation.

Exposure Categories are used to designate the likelihood of persons being present in structures or on public roads during periods when shallow, rapidly moving landslides may occur. There are three exposure categories that can trigger the shallow, rapidly moving landslides and public safety rules, as described in OAR 629-623-0200(2-4). If the exposure category determination is unclear due to the condition of the structure, the definition of a habitable residence can be further clarified by the State Forester.

Exposure Category A includes habitable residences, schools, and other buildings where people are normally present during periods when wet season rainstorms are common.

Exposure Category B includes paved public roads averaging over 500 vehicles per day (VPD), as determined, if possible, during periods when wet season rainstorms are common.

Exposure Category C includes barns, outbuildings, recreational dwellings not included in Exposure Category A, low-use public roads (not including those used primarily for forest management), and other constructed facilities where people are not usually present when wet season rainstorms are common.

Periods when wet season rainstorms are common

Periods when wet season rainstorms are common generally means November 1st through April 30th. If the building is occupied during the winter, it is Exposure Category A. If a building is occupied mostly in the summer, it is Exposure Category C. Outbuildings, such as barns or detached garages, are not normally considered to be occupied buildings and are typically in Exposure Category C.

Evaluating traffic volume

When available, official traffic data should be used to evaluate traffic volume. Data is collected at specific mileposts and times of the year and needs some judgement to extrapolate for the specific notified location. Data collected during summer months may be greater than what occurs for the same location during the wet season.

[2] The Oregon Department of Geology and Mineral Industries (DOGAMI) Statewide Buildings Footprints for Oregon, release 1.0 (SBFO-1), by Matt C. Williams contains a database of building footprints in Oregon from ~2018. It is available at https://pubs.oregon.gov/dogami/dds/p-SBFO-1.htm. It is intended to be used for informational purposes only and cannot substitute for site-specific investigations by qualified practitioners. It may not include newer construction after 2018.

For State highways, traffic volume data is located at:
http://www.oregon.gov/ODOT/TD/TDATA/Pages/tsm/tvt.aspx#Traffic_Volume_Tables

For cities and counties that maintain their own traffic data websites, data can be found here: http://www.oregon.gov/ODOT/Data/Pages/Traffic-Counting.aspx. Move to the bottom of the page and find "other jurisdictions traffic counting websites".

For county roads not listed on the sites above, contact the public works/planning department for the county in question and ask for data for the nearest mileposts on either side of the notified area.

For roads where data is not available, VPD can be estimated by one of the following two methods:

Method 1) Using an ortho-photo or site visit, count the homes in the area which are likely to make daily trips past the notified area. Some local knowledge of the area will be required to make this assumption. Assuming three drivers per home will each make three separate daily roundtrips (conservative) past the site, multiply the number of homes by 18 (three drivers each make six trips past the site).

Method 2) Count morning peak traffic to estimate VPD. Observations need to start in the morning of a weekday, just before peak volume is expected and continue until one is certain the peak morning traffic flow is over. This process may take a couple of hours and may be accomplished with road tube traffic counters or by visual, in person observations. For each five-minute interval, record the number of vehicles passing the notified area. Count each vehicle regardless of how many times it passes your point of interest or the direction it is moving. After data is collected, add up the three consecutive five-minute intervals with the most vehicles. Use this number with the following procedure to estimate your daily volume (after http://www.clrp.cornell.edu/q-a/212-TrafficCounts.html).

Take a 15-minute count during the busiest time of day. Convert that to a daily count using the following formula: Estimated Daily traffic = C*F. Where C = 15-minute count, F = multiplier based upon area:

- 36 in urban area;
- 33 in suburban area;
- 27 in rural area

As an example, if the count is 106 cars in 15 minutes in a suburban area, the estimated daily count would be 3,500 (106*33=3,498). These approximations only work if there is free flowing traffic (not a traffic jam).

In the absence of official traffic count data or data obtained through the two VPD methods described above, double-lane, paved county and state roads are considered to be high traffic volume roads (Exposure Category B).

STEP 3: DETERMINING THE IMPACT RATING

Impact Ratings

The impact rating reflects the expected frequency and severity of impact from a shallow rapidly moving landslide on a structure or road. Property damage alone is not considered in determination of impact rating. OAR 629-623-0250(3) allows the State Forester to require the landowner to submit a geotechnical determination of shallow, rapidly moving landslide impact rating for any structures or roads meeting Exposure Categories A, B, and in some cases C, within the further review area in or below the operation.

A Geotechnical Specialist, normally an Oregon registered Professional Engineer (PE) or a Certified Engineering Geologist (CEG), may conduct the geotechnical determination of rapidly moving landslide impact rating. *Forest Practices Technical Note Number 6: Determination of Rapidly Moving Landslide Impact Rating*, was designed for these geotechnical determinations. After the operator has submitted the geotechnical report, the State Forester will review the final impact rating and other information provided in the geotechnical report. The State Forester has the final determination of the impact rating [OAR 629-623-0250(5)]. Landowners should consult with ODF before enlisting the services of a Geotechnical Specialist.

Impact rating factors are almost always informed by natural geomorphology and may include but are not limited to: the location of structures or roads in relation to the debris torrent-prone stream or steep slope, channel confinement, channel gradient, channel junction angles, and debris in the channel [OAR 629-623-0250(1)]. However, changes to the impact rating can be warranted if some sort of mitigation designed and inspected by a Geotechnical Specialist has occurred (OAR 629-623-0800). Specifically, debris torrent deflection structures have been used to protect homes in some cases and can be constructed as part of a forest operation to make timber on HLHL available for harvest. The Geotechnical Specialist should take any mitigation structure into consideration after proper analysis of its efficacy and may change the impact rating accordingly.

Rapidly moving landslide impact potential is rated as ***unlikely, moderate, serious*** and, in limited cases, ***extreme*** [OAR 629-623-0250(2)].

Rapidly moving landslide impact rating definitions

- **"Unlikely"** impact rating indicates that any shallow, rapidly moving landslide initiating within the operation area is unlikely to reach the structure or road.
- **"Moderate"** impact rating indicates that it is uncertain whether any shallow, rapidly moving landslide initiating within the operation area is likely or unlikely to directly impact a structure or road. Dangerous impacts cannot be reasonably ruled out.
- **"Serious"** impact rating indicates that any shallow, rapidly moving landslide initiating within the operation area is likely to directly impact a structure or road.
- **"Extreme"** impact rating indicates that any shallow, rapidly moving landslide initiating within the operation area is likely to directly impact a structure or road and, in addition, there are unusual conditions that make dangerous impacts almost certain.

Special circumstances
Certain structures in the path of rapidly moving landslides such as dams, powerlines or oil tanks, that might fail upon impact and injure people in structures or on roads further downstream should also be included in the impact rating [OAR 629-623-0250(4)].

STEP 4. DETERMINING THE DOWNSLOPE PUBLIC SAFETY RISK LEVEL
Downslope public safety risk levels are based on the exposure category (from Step 2) and the rapidly moving landslide impact rating (from Step 3). Downslope public safety risk level is characterized as either "substantial," "intermediate," or "low."

Table 2 is a matrix that shows how Exposure Category (OAR 629-623-0200) and Rapidly Moving Landslide Impact Rating (OAR 629-623-0250) are used to determine Public Safety Risk Level (OAR 629-623-0300).

Table 2. Public Safety Risk Levels

Exposure Category	Rapidly Moving Landslide Impact Rating			
	EXTREME	***SERIOUS***	***MODERATE***	***UNLIKELY***
A	Substantial	Substantial	Intermediate	Low
B	Substantial	Intermediate	Low	Low
C	Intermediate	Low	Low	Low

STEP 5. DETERMINING THE ALLOWABLE HARVESTING AND ROAD BUILDING PRACTICES
Substantial downslope public safety risk (OAR 629-623-0400 and 629-623-0450)
Some forest practices on or near locations with substantial downslope public safety risk are prohibited. These include all timber harvest and new road construction on high landslide hazard locations that contribute to that risk (with some exceptions). Operators may reconstruct existing roads on HLHLs when the written plan required by OAR 629-623-0700 incorporates site-specific practices as directed by a Geotechnical Specialist and demonstrates that road reconstruction will reduce landslide hazard [OAR 629-623-0450(2)]. Removal of dead or diseased trees, trees from sites that have already failed or trees that have blown over may also be allowed. The operator must demonstrate that this results in no increased downslope public safety risk. When operating under these exceptions, these slopes must be protected from increased soil disturbance during forestry activities and must be rapidly reforested.

Operators should be aware that windthrow may be a factor contributing to shallow, rapidly moving landslides. Trees retained on HLHLs with substantial downslope public safety risk must remain windfirm. The operator should consider the wind firmness of trees that are to be left on HLHLs and will likely need to leave additional trees outside the boundaries of the unharvested HLHL area to reduce windthrow hazard to the retained trees. Crown and bole characteristics, exposure to prevailing storm winds, topographic effects, relative height of trees, and species mix (conifer/hardwood) should be evaluated when determining harvest unit boundaries when HLHLs are present. Removal of trees that can impact structures or roads can be allowed if the

risk to these homes or roads from windthrow is greater than the risk from shallow, rapidly moving landslides.

Intermediate downslope public safety risk (OAR 629-623-0500 and 629-623-0550)
Operations with intermediate downslope public safety risk require that no more than half the HLHLs that contribute to that risk on a single ownership within the basin (for debris torrents) or hillslope (for open-slope debris flows) are in the 0-to-9-year age class or with otherwise reduced canopy closure in other age classes. This can allow for limited clearcutting. Thinning or partial cutting is allowed on all of the HLHLs to the extent that a healthy canopy is maintained during and after harvest. Given the variability of stand and site conditions across the state, setting a specific target (stems per acre, canopy closure, basal area, etc.) is difficult. The trees left after harvest should have healthy crowns and be capable of responding with rapid canopy and root regrowth after thinning. One acceptable strategy is to thin from below, retaining most of the dominant and co-dominant trees. The final density after thinning should be no lower than 30% of the maximum stand density index, with an increase in average tree diameter. This strategy, or any other thinning regime that recovers crown closure in ten years or less is acceptable.

Note that high-grading, selecting the largest trees for removal, will not result in rapid canopy closure, and is not an acceptable intermediate public safety risk practice. The long-term objective is full evergreen canopy cover as a surrogate for winter water interception and coarse and fine root mass regrowth. Proposed silvicultural prescriptions in the required written plan will be evaluated in terms of their abilities to achieve that objective. Thinning or partial cutting of predominately hardwood stands, unless it is done to encourage conifer growth or regrowth, is generally not considered an acceptable silvicultural practice for maintaining or enhancing canopy cover.

When constructing roads on HLHLs or other very steep slopes with intermediate downslope public safety risk, operators shall follow site-specific practices as directed by a Geotechnical Specialist [OAR 629-623-0550(1)]. Road construction operations require the operator to address, in the written plan, an evaluation of cutslope stability and other measures to prevent water from draining onto HLHLs. Generally, this will require operator-provided Geotechnical Specialist involvement.

Low downslope public safety risk (OAR 629-630-0500)
Harvesting and road building operations are not subject to restrictions when there is low downslope public safety risk.

Other Considerations

Protection along debris torrent-prone streams (OAR 629-623-0600)
Debris torrent-prone streams include confined channels and slopes below HLHLs with gradients steep enough to allow shallow, rapid landslide movement. Woody debris loading should be minimized in these channels and large standing trees should be left where they might slow debris torrents where there is substantial or intermediate downslope public safety risk. Even if

the HLHL contributing to that risk is not within the operation unit but is above or outside the unit, protection of the depositional reach is still required.

Natural Resource Protection
Natural resource protection rules apply to all operations that contain HLHLs regardless of downslope public safety risk. When harvesting on **any** HLHLs operators must not construct skid roads or use ground-based equipment on these sites and must ensure that log felling and yarding operations do not result in extensive disturbance or gouging (OAR 629-630-0500).

Operators should also be aware of the January 1, 2024 steep slopes harvesting rules in OAR 629-630-0900 through 0925. These rules include leaving trees on mapped features identified by a model and available on the ODF website. Some of these features may include HLHLs but the rules are separate from the Division 623 Landslide and Public Safety rules.

Administration of the Shallow, Rapidly Moving Landslides and Public Safety Rules

The Department of Forestry will evaluate Notifications of Operations for applicability of the Shallow, Rapidly Moving Landslides and Public Safety Rules. Operators will be informed if there may be high landslide hazard locations within the operation area. It is the operators' responsibility to then use this technical note to confirm the HLHLs, and to identify the presence of structures and paved public roads within further review areas. It is also the operators' responsibility to obtain geotechnical services for determination of the impact rating for the operation. After the operator has submitted the geotechnical report, the State Forester will review the final impact rating based on information provided in the geotechnical report. The State Forester has the final determination of the impact rating. Oregon Department of Forestry Geotechnical Specialists are available to assist forest practices foresters as needed.

Written Plan Requirements

For operations with substantial or intermediate public safety risk, the operator must submit a written plan (OAR 629-623-0700) that includes:

- A determination of public safety risk based on the impact rating for the operation;
- A map showing those portion(s) of the operation containing high landslide hazard locations;
- The location of all existing and proposed new roads crossing high landslide hazard locations;
- A detailed road design for all new or reconstructed roads crossing high landslide hazard locations;
- The location of habitable structures (Exposure Category A) and paved public roads (Exposure Category B) below the operation and within further review areas;
- Locations where timber harvesting will not occur, including buffers for wind firmness;
- Locations where partial cutting will occur and the specific silvicultural prescription; and
- Additional information related to the operation, as requested by the State Forester.

If an impact rating was determined for an operation, then the geotechnical report or communication documenting that determination needs to be uploaded to ODF's Forest Activity Electronic Reporting and Notification System (FERNS) so that it can be reviewed by an ODF Geotechnical Specialist. Since HLHLs outside of and near notified boundaries can still require windfirm buffers within the notified area, this also provides an opportunity to make sure appropriate windfirm buffers will be established for operations with substantial risk. It also can help ensure that proper intermediate risk harvest restrictions will be followed.

Limitations

These criteria, and the forest practice rules that apply to other forest operations, are intended to minimize disturbances to high landslide hazard locations, but do not eliminate downslope risks. Shallow, rapidly moving landslides occur in both forested and non-forested areas alike. The shallow, rapidly moving landslide rules do not eliminate the landslide threat to downslope occupied buildings or high traffic volume roads. Less steep slopes may still be subject to a lower landslide hazard, and there are also other types of landslides that may pose a threat to public safety.

Sources of More Detailed Technical Information

Benda, L., and T. Cundy. 1990. Predicting deposition of debris flows in mountain channels. Canadian Geotechnical Journal. Volume 27, Number 4. pp 409-417.

Mills, K. & Hinkle, J. 2001. Landslides and Public Safety: an Issue Paper prepared for the Oregon Board of Forestry. Oregon Department of Forestry.

Oregon Department of Forestry 2003. Forest Practices Technical Note Number 6; Determination of Rapidly Moving Landslide Impact Rating.

Robison, E. G., K. Mills, J. T. Paul, L. Dent, and A. Skaugset. 1999. Oregon Department of Forestry 1996 Storm Impacts Monitoring Project: Final Report. Forest Practices Technical Report #4. Oregon Department of Forestry, Salem, Oregon. 141 pp.

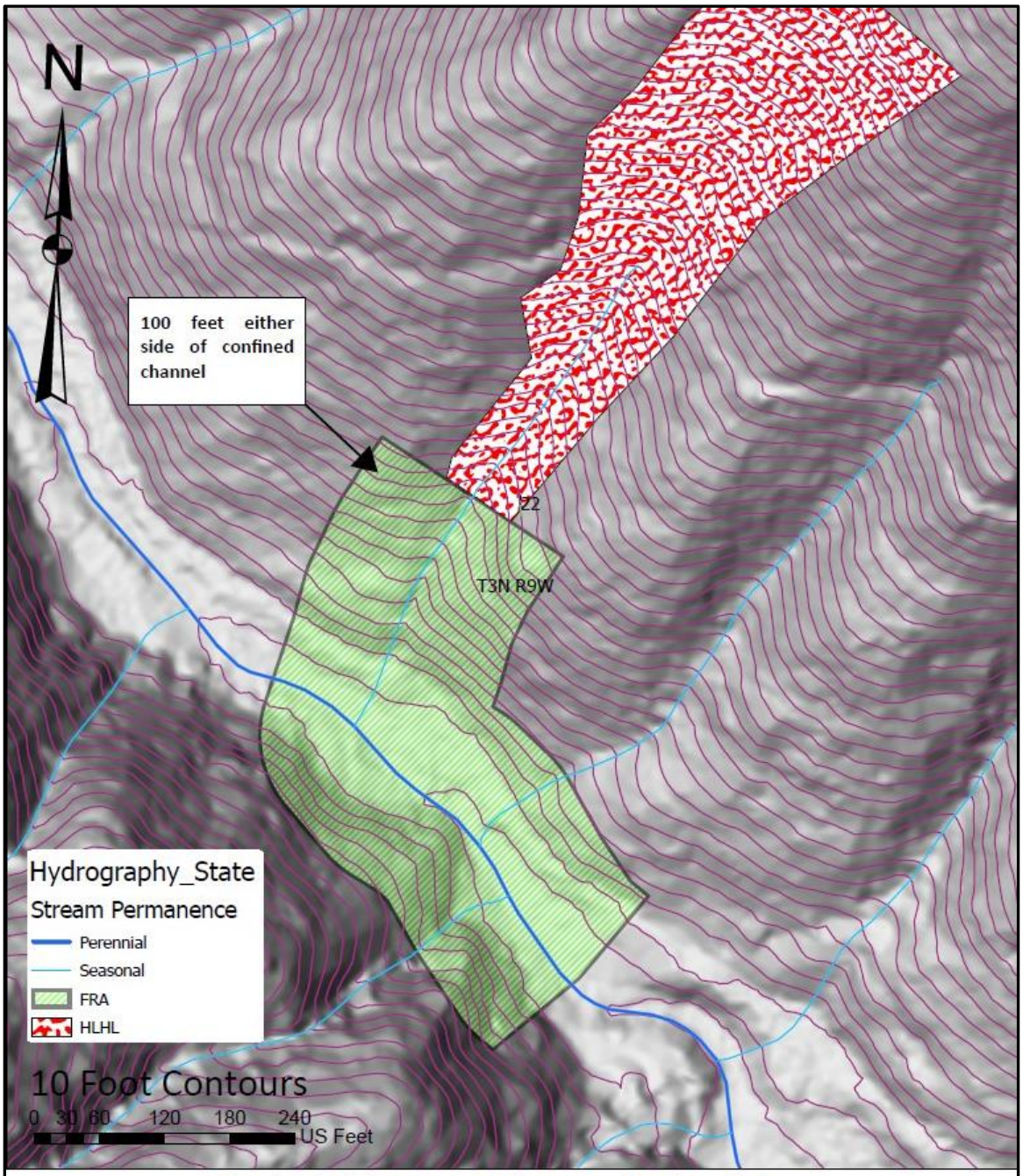
Turner, T. R., Duke, S. D., Fransen, B. R., Reiter, M. L., Kroll, A. J., Ward, J. W., Bach, J. L. Justice, T. E., & Bilby, R. E. (2010). Landslide densities associated with rainfall, stand age, and topography on forested landscapes, southwestern Washington, USA. Forest Ecology and Management, 259(12), 2233–2247. https://doi.org/10.1016/j.foreco.2010.01.051

Estimating traffic http://www.clrp.cornell.edu/q-a/212-TrafficCounts.html

Oregon Department of Forestry Field Offices

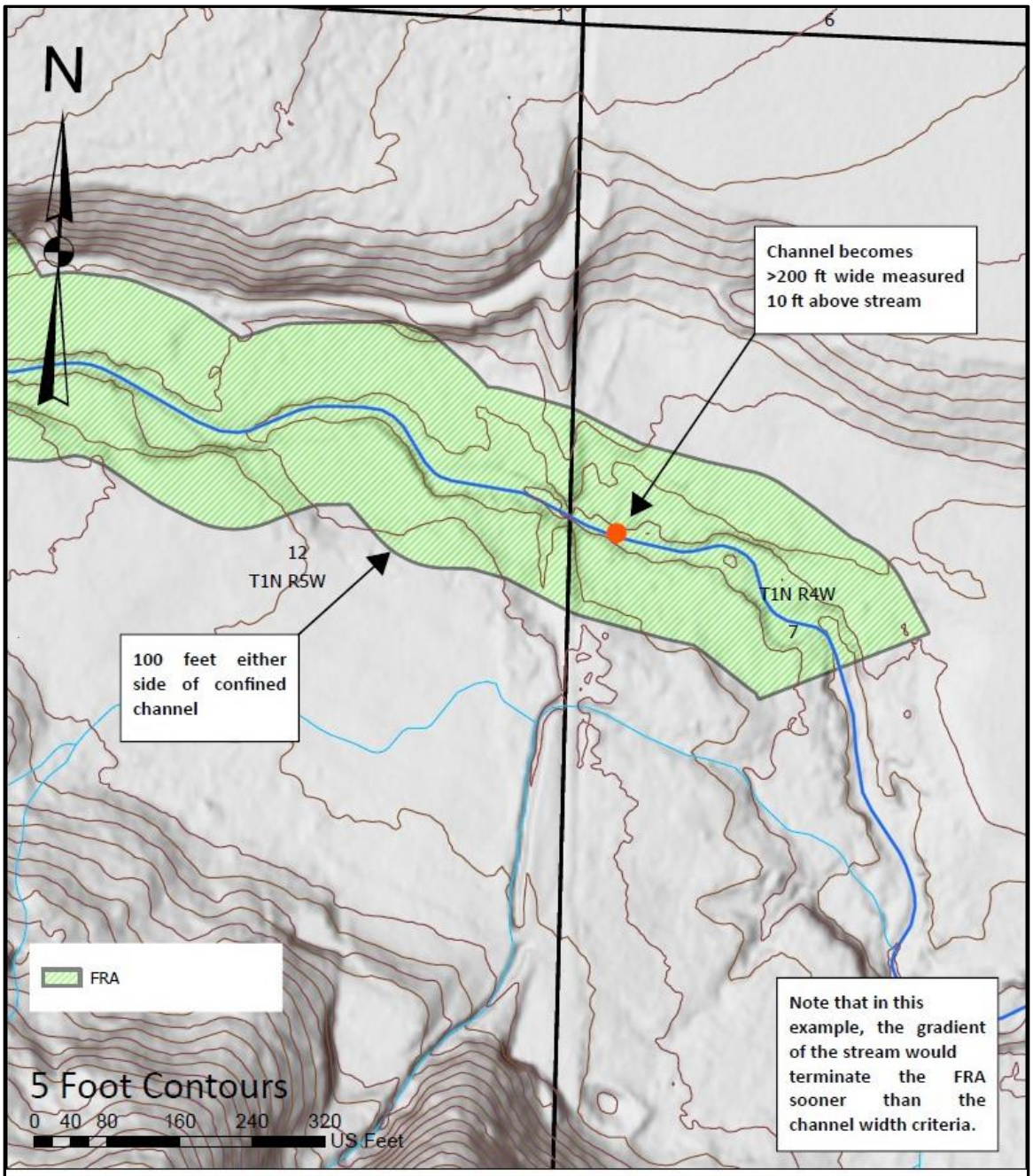
For more information on the Oregon Forest Practices Act and Forest Practice Rules, please contact your local ODF office at http://www.oregon.gov/ODF/Working/Pages/FindAForester.aspx or the headquarters office at 2600 State Street, Salem, Oregon 97310. 503-945-7200.

APPENDIX A
Examples of the Five Further Review Area Cases



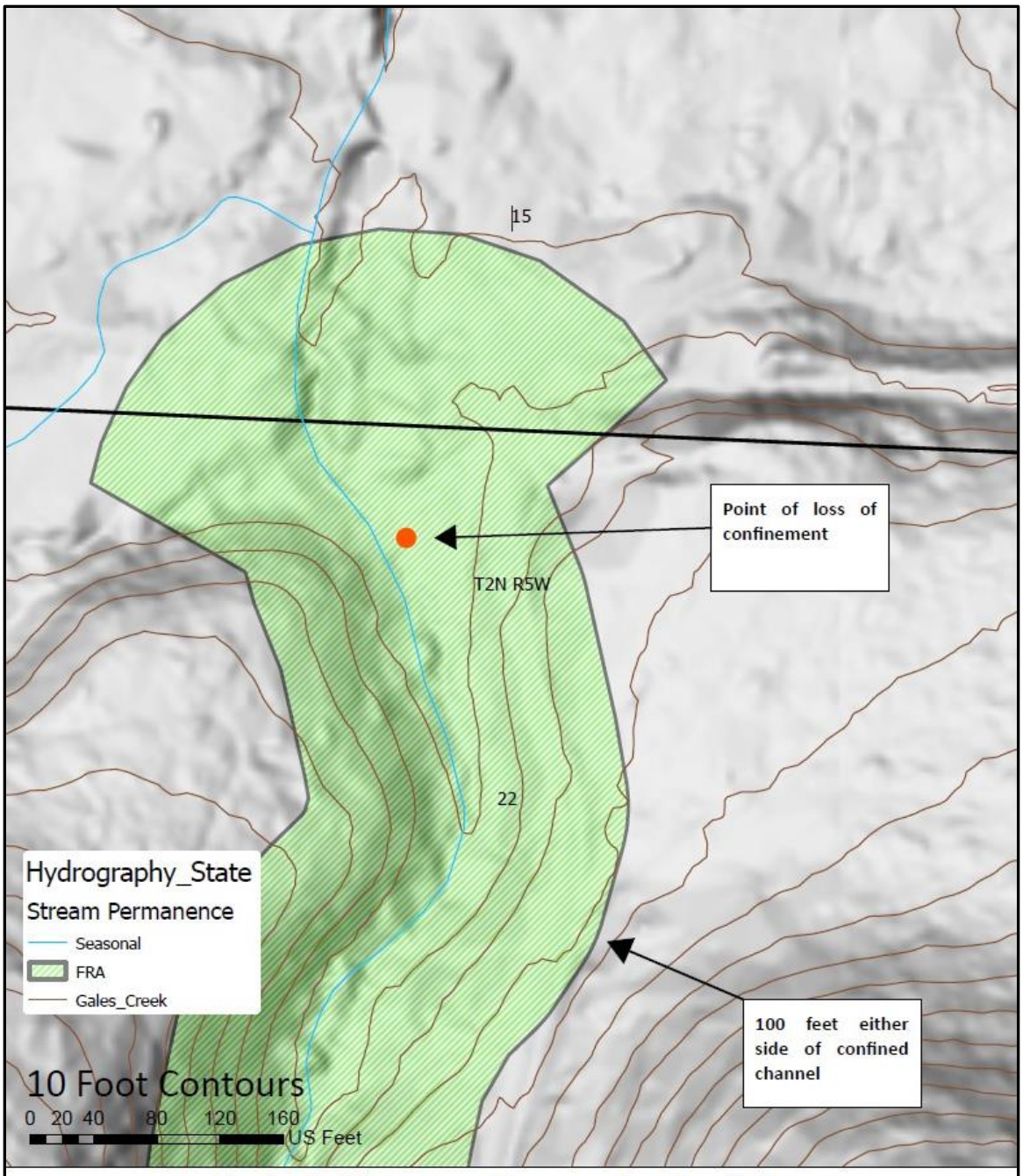
Debris Torrent Example 1 of 3

"FRA ends when channel gradient becomes =< 6% for at least 300 ft"



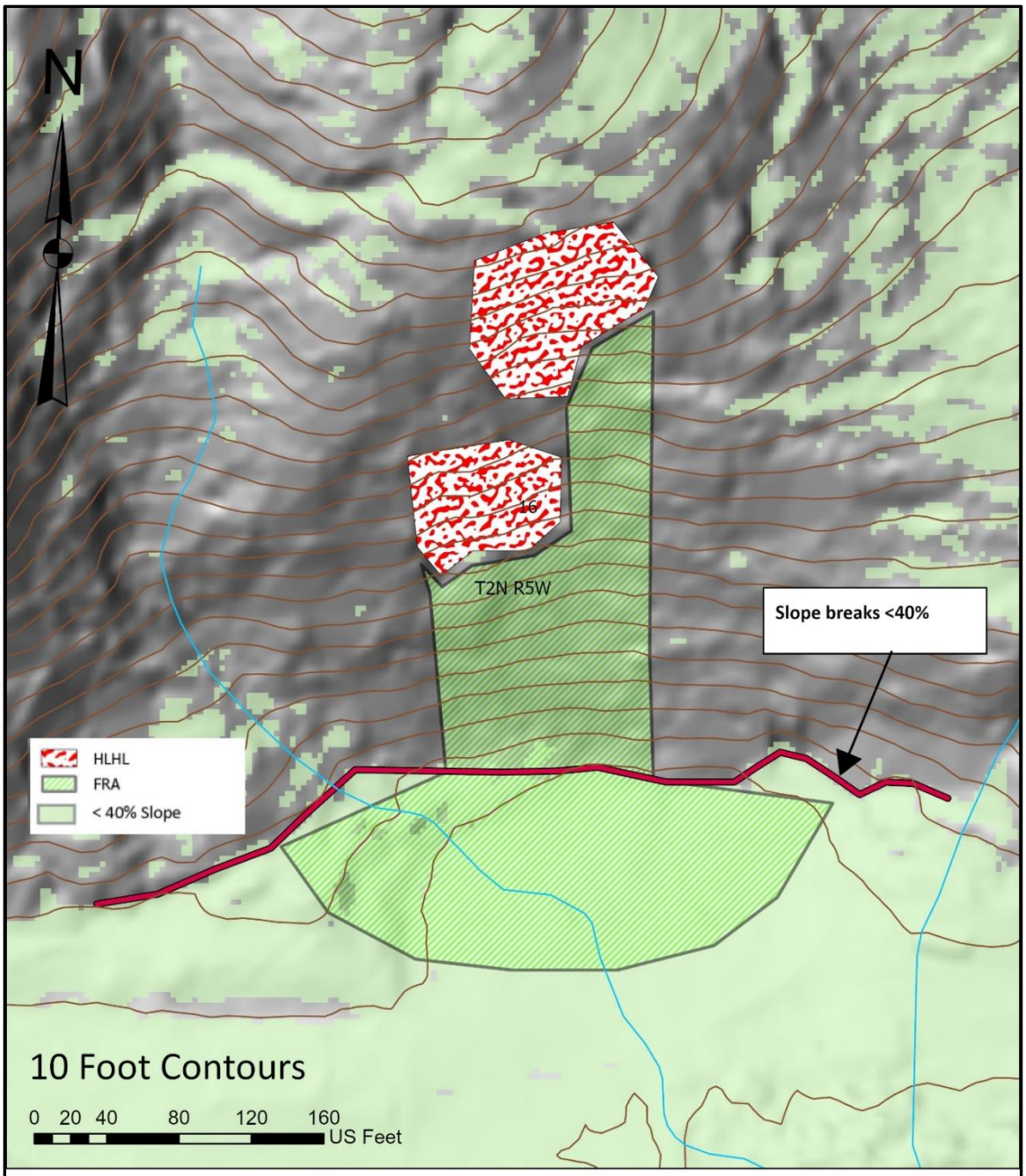
Debris Torrent Example 2 of 3

"FRA ends when channel width exceeds 200 ft or more for =>300 ft"



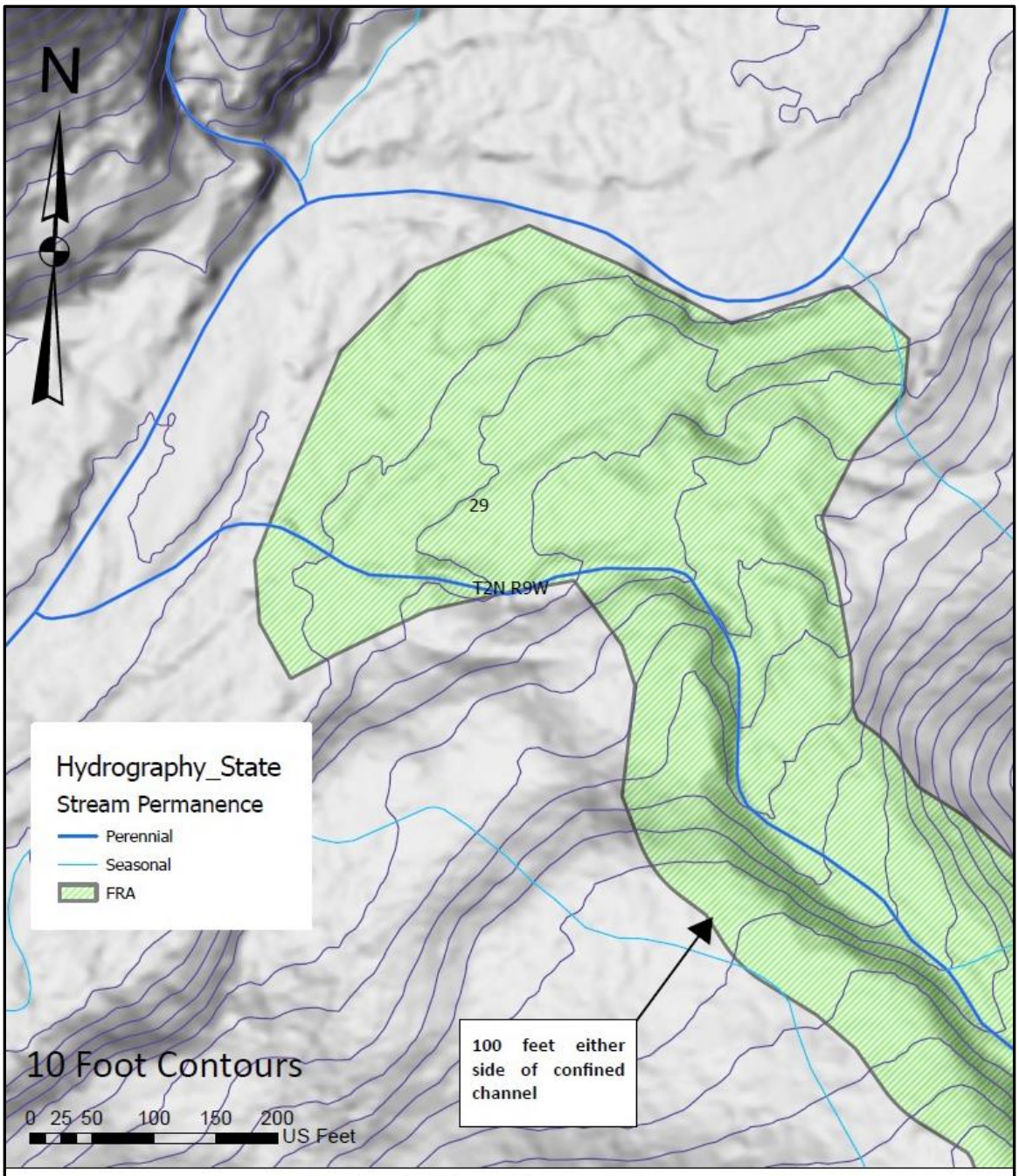
Debris Torrent Example 3 of 3

"FRA ends when channel looses confinement, such as at the mouth of a canyon. The FRA extends 200 ft from point the channel looses confinement."



Open Slope Debris Flow Example

"FRA ends 100 ft downslope after the slope gradient drops to and remains below 40%"



Debris Fan Example

"FRA continues to the lower edge of the debris fan"