

# Document 2c

*For 11 December 2025 IRST meeting*

## RSHC Monitoring Draft2 Technical Approach

[Section II.C. Project and Proposal Criteria (what we seek to achieve)]

In order to assess the baseline status of road-stream hydrologic connectivity (RSHC) under the new Oregon Forest Practices Rules, we are requesting proposals to conduct field surveys and sediment modeling, as well as two pre-survey options that could be used in planning the field survey, helping to better target where and what data are collected in the field.

As part of this study, summary statistics will be calculated on each measured variable related to RSHC for each reporting unit (e.g., all the roads in a watershed or land grid). The baseline status will be summarized by strata (landowner class in each geo-region). Depending on the sampling approach, the summarized baseline status could be metrics like the length of connected road over total road length (or sampled area) or length of connected road per length of potentially connected road. Sediment metrics could include density of sediment delivery to streams (tons/sq mi/year), volume of road sediment delivered to streams per mile of stream (tons/stream mi/year), and characteristics of high delivery road segments (surfacing, traffic, etc.).

## Sampling Design

Two possible sampling approaches are the land-grid-based road census approach (used by Dubé et al. 2010) and a watershed-based approach. The latter approach would be sample within 12th code hydrologic units (HUC 12) that have significant private forestland ownership.

Advantages of watershed-based investigation of hydrologic connectivity of forest roads:

- Generally, each watershed or sub-watershed is developed in a specific and definable geologic setting. This often means that slopes and soils may be consistent throughout that watershed. However, some variables, including tectonic history (faults, joint patterns, etc.) slope aspect and elevation of the watershed will introduce variables that may not conform to geologic characteristics of other watershed with similar bedrock, but dissimilar elevation and slope aspect and tectonic control.
- Where roads are developed on native material, consistency of soil types and hydrologic characteristics under similar weather and traffic loads throughout the watershed may make analysis of other variables easier and more consistent.
- Slopes of roads may be more consistent in watersheds with similar geology. For example, where the terrain is based in Columbia River basalts, roads may include short stretches of relatively steep slopes if climbing from one basalt flow to another, and longer stretches with more gentle slopes.
- Within a watershed, vegetation/ground cover may be more consistent, based upon similar soil types. across the sample area. This may provide some consistency of the capacity of soils and

biota to moderate (or not) the amount of precipitation, snowmelt, etc. that reaches the road network.

Potential disadvantages of watershed-based investigation of roads' hydrologic connectivity:

- Possible challenge of locating sufficient small landowner parcels within the same watershed to make small landowner assessments.
- Roads may traverse multiple watersheds and in some (rare) cases might mean including hydrologic data for runoff that may not have originated in that watershed.

Either approach will require a large random sample to provide valid statistical data to draw inferences and detect trends across the state of Oregon. The sample is requested to be stratified by landowner type (large/small) and geography (eastside/westside) (see Definitions section). A statistical power analysis will be necessary to determine the sample size needed for each stratum and sampling period to reliably evaluate the baseline status and detect trends. We also request that applicants describe how their sampling design will support trend analysis. Numerous sampling designs are possible for trend analysis, including paired, unpaired, and rotating panel designs.

## Pre-survey Option 1: Assessing Roads and Streams Digital Data

One potential way to boost sampling efficiency could be to preselect and sample only road segments with a high probability of being hydrologically connected, using either a simple distance buffer or one of the RSHC models. However, the utility of these locations for field work and avoiding potential sampling bias will depend on the accuracy of the stream and road data used to identify field sampling locations.

ODF's hydrography layer and ODF's transportation layer (both available from their [GIS Data Hub](#)) are considered the most comprehensive coverages available for private forestland in Oregon. However, the accuracy and completeness of the layers is not well quantified. Thus, using these layers to guide sampling for RSHC may introduce an unknown level of bias into estimates. If an applicant chooses this type of preselection, we request they describe how the accuracy of these data layers might be assessed and sampling bias minimized.

## Pre-survey Option 2: GIS-LiDAR Road Segment Analysis

Identifying road segments and measuring the associated attributes needed for RSHC analysis and sediment modeling takes considerable time in the field. The literature suggests that GIS (desktop) analysis prior to fieldwork could be used to generate road segments and properties from publicly available airborne LiDAR data. The goal of this option would be to test whether such an approach improves the accuracy and efficiency of road segment creation and the quantification of segment characteristics needed for RSHC analysis.

After overlaying the ODF road network atop airborne LiDAR, flow routing algorithms and other GIS tools could be used to distinguish road segments and attribute those segments with estimates of relevant properties, including length, slope, configuration, ditch width/position, cut slope height, tread width, and other geometric data. Field crews could then focus on documenting site-specific information such as road surfacing.

This approach would require workflow development and testing before adoption and rollout for field crews. Also, some legacy (or older) LiDAR datasets have lower point density, thus testing would be

necessary to determine whether data limitations exist. Field validation would also be needed to assess the accuracy of this approach.

## **Field Survey**

RSHC will be assessed using field surveys, and associated data will be collected to run a sediment delivery model. We envision data collection methods similar to the field protocol of Dubé et al. (2010), as described in Watershed Professionals Network (2009) with potentially more recent updates (e.g., Bohle and Dubé 2016). Field crews will drive roads included in the sample and use GPS to spatially record features indicating various types and levels of connectivity (such as the five types in Dubé et al. (2010)).

Applicants should describe how they would assess how particular elements of the regulatory framework (e.g., road location) or site characteristics (e.g. geology) contribute to hydrologic connectivity. Additional data will be collected to support modeling the estimated amounts of sediment generation and delivery. Raines et al. (2005) describes the types of variables for which field data will be collected. These include variables such as road surface, road age, and cut slope vegetation coverage. Other needed variables (e.g., road traffic or maintenance activities) may be derived from landowner interviews. The exact variables will depend on the model selected.

Applicants should describe how they would implement quality assurance and control (QA/QC) for the data collection, including field crew training and the measurement and minimization of inter-observer variability.

## **Landowner Participation**

Landowner permission will need to be secured before conducting monitoring on their lands. While landowners are required to allow access to their lands for compliance monitoring related to activities reporting requirements, they are not required to allow access for effectiveness monitoring. ODF staff and some stakeholder groups (Oregon Forest Industries Council, Oregon Small Woodlands Association, Association of Oregon Loggers) have expressed that they have interest in supporting the landowner outreach efforts. The applicant should describe their outreach approach, and how they would address sampling gaps caused by lack of permission issues.

## **Modeling of sediment generation and delivery**

The chronic delivery of fine sediments to streams and their effect on aquatic organisms is one of the principal concerns of RSHC. While connectivity is needed to deliver sediment, the amount of sediment delivered will depend on a number of local factors. The applicant should describe how they will estimate sediment delivery based on their field collected and other available data.

## **Baseline Status and Trend Analysis**

The baseline for RSHC monitoring is the status of roads when the new rules went into effect on Jan 1, 2024. Since actual field assessment will not begin until considerably after that date, the applicant should consider how to adjust data to achieve the most accurate baseline possible. The new rules include a Forest Roads Inventory and Analysis (FRIA) process that directs large landowners to begin, as soon as possible, identifying and remediating high conservation value sites. These are areas known to have road stream connectivity or chronic sedimentation. Small landowners are exempt from FRIA but must conduct a Road Condition Assessment (RCA) for roads used in active harvest operations. These data will be

reported to ODF and could be used to help identify road segments affected by these post-rule changes, which then could either be dropped from the sample or assumed connected in the baseline.

Although this RFP only covers baseline data collection, applicants should describe how their sampling design would support trend analysis. The stakeholder committee requested a trend analysis at 5-year intervals.