

Research question(s) for the research topic: Requirements of baseline and trend monitoring of road rules

This document provides the verbatim input from AMPC members on the draft research question packages Terry Frueh emailed to the AMPC on Sept. 1, 2023.

From Dave Bugni (highlighted)

Research questions

1. What are the baseline and trends in hydrologic connectivity of roads per the relevant rules?
2. Several rules for hydrologic disconnection use the term “maximum extent practicable”. When rules with this term are complied with, are they effective at achieving the goals of rules?
3. What is the current diversity of agency, operator, landowner, and other stakeholder understanding of “maximum extent practicable” with regards to hydrologic disconnection?
4. A question I have pertains to the determination of the actual sediment input a road may have compared to the background forest during a precipitation event. For example, if no road was present, some sediment still makes its way into a drainage. This can be both detrimental and beneficial, as we know. When a road is constructed, such sediment may increase depending upon a variety of factors as we have been discussing. I believe it is important to establish a baseline measurement of the background sediment input from the surrounding forested environment to determine the extent, if any, of sediment input from a particular road system. Is the problem nonlinear – that is – does the level of a precipitation event matter to degrees that need study of both minor and major precipitation events? Landowners should not be forced to make the system any better than the natural background system if no road is present (but could voluntarily choose to do so if they desire). Also, from a practical standpoint, some small level of increase above the background level of potential sedimentation should be considered for a road (e.g. 5% - or how much is considered to be a problem?). So, any study should consider this when attempting to quantify effects of roads on sediment inputs. Since road conditions are dynamic (they will change over time depending upon the severity of natural weather events causing erosion and levels of periodic maintenance, etc) how will all that be reflected (monitored) in any study? Seems to me this will need to be a large data effort to quantify these effects as well as the variables further outlined below.

Commented [FT*O1]: Although this term is not defined in rule, it's better than "disconnection" which focuses on the ACT of removing connectivity, when we really want to know the status of connectivity

Questions for the IRST to help hone the Research Questions

1. What are some good approaches to stratify the aforementioned research questions regionally, considering:
 - a. The regions need to be relevant and practicable from a regulatory perspective [this aspect would be addressed in conversation with ODF subject matter experts];
 - b. Need the number of regions studied to be cost-effective (e.g., obviously couldn't have 100 regions, but probably more like 2-8 regions);

- c. What are good “filters” with which to create regions within which there is a “reasonable” amount of similarity, e.g.,
- i. Precipitation – quantity, type (rain- vs. snow-dominated)
 - ii. Geology
 - iii. Gradient or relief (including local topography (e.g. a road built on steep slopes or unstable ground))
 - iv. Supporting soil types
 - v. Ranges of protected species
 - vi. There are also different types of road surfaces (i.e. 1) all weather, well graveled and 2) seasonal (dirt)). Each type will have different levels of potential sediment input. Roads also have different levels/types/practices of road construction:
 1. Subbases
 2. Levels of compaction
 3. Active versus abandoned
 4. Levels of periodic maintenance
 5. Side ditches
 6. Water bars
 7. Proper slopes (out, in, cross)
 8. Etc
 9. Frequency of use
 10. All this leads to a complex categorization challenge – so as to not oversimplify a road’s contribution to any potential sedimentation – we don’t want to penalize a good quality, well-maintained and engineered road.
2. The road rules and FRIA will be implemented over the coming 20 years. Given this, what is a reasonable and cost-effective frequency to assess the trends in hydrologic disconnection? E.g., every 3 years, 5 years, 7 years...; note the importance of starting the data collection ASAP to have a solid baseline. (I believe we would need to get an estimate of cost for each proposed cycle to determine this.)
3. For study design on these research questions to look at trends over time, what are pros and cons of doing these in paired (i.e., revisiting same sites) vs. unpaired.
4. How best to stratify based on landowner type? Looking at two landowner types:
- a. Small Forestland Owners per OAR 629-600-0100(126)
 - b. All other landowners subject to the FPA.
 - c. On one side of the coin: nature does not know whether the road was built by an SFO or industrial forestland owner; however, the flip side certainly points to different levels of capital outlay, financial resources and extent of use of a road over the road’s lifetime. So, any study should reflect ownership type as well.
5. While the following topic is probably outside the scope of our involvement, it appears to be a problem and I would like to know its relative severity compared to sedimentation. The problem I am referring to is the presence of 6PPD-quinine, which is a chemical that comes from the 6PPD found in tires and has been found to be very harmful to coho salmon in particular: <https://www.washington.edu/news/2020/12/03/tire-related->

[chemical-largely-responsible-for-adult-coho-salmon-deaths-in-urban-streams/](#) . So, on roads that are constructed from impervious materials, which all traffic uses to varying degrees, and where these compounds can then find their way into freshwater drainages, how big of a problem is this compared to sedimentation? Should some effort also be brought to bear on this (most likely not an ODF problem), or is it too early to tell?

Research Question Package (OAR 629-603-0200 (3)(a) requirements)

OAR 629-603-0200(3)(a) The AMPC shall succinctly specify preliminary research questions that include the following:

OAR 629-603-0200(3)(a)(A) The **type** of research and monitoring per OAR 629-603-0100(1)(a) or (b)

OAR 629-603-0100(1)(a) Conduct effectiveness monitoring by assessing the degree to which the rules facilitating particular forest conditions and ecological processes achieve the biological goals and objectives. This assessment may include evaluation of cumulative effects.

OAR 629-603-0100(1)(b) Conduct research inquiry and validation monitoring to:

- (A) Determine if additional scientific inquiry is needed to fill knowledge gaps related to biological goals and objectives; and
- (B) Test and improve existing and new models and methodologies used to design and implement forest practice rules intended to meet the biological goals and objectives.

This research is of type OAR 629-603-0100(1)(a)

OAR 629-603-0200(3)(a)(B) The **rule, biological goals and objectives, or other issue** being studied;

The rules being studied are:

OAR 629-625-0300 Road design

(3) The department shall publish Forest Practices Technical Guidance that explains how to avoid and prevent potential impacts to fish, wildlife, habitat resources, and waters of the state, in support of the following rules:

(g) OAR 629-625-0330(1) to explain how to implement rules to hydrologically disconnect forest roads and landings from waters of the state.

OAR 629-625-0320 Water Crossing Structures;

(10) Construction of Water Crossings. In the construction of water crossings, operators shall do the following:

(b) Runoff, Erosion and Sediment. Operators shall control runoff, erosion, and sediment through the following actions:

(A) Include a site-specific erosion and sediment control plan as part of a written plan prior to beginning work. This plan must include, but is not limited to:

- (i) A site plan with a description of the methods of erosion or sediment control;*
- (ii) Methods for confining, removing, and disposing of excess construction materials; and*

Commented [FT*O2]: BGOs aren't finalized, so can't really link back to them. Are there other issues to be addressed, other than the rules listed?

- (iii) Measures to disconnect road surface and ditch water from all typed waters and lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, wetlands, inlets, and canals.

OAR 629-625-0330 Drainage

(1) All active, inactive, and vacated forest roads and landings shall be hydrologically disconnected to the maximum extent practicable from waters of the state to minimize sediment delivery from road runoff and reduce the potential for hydrological changes that alter the magnitude and frequency of runoff. Operators shall locate drainage structures based on the priority listed below. When there is a conflict between the requirements of sections (2) through (7) of this rule, the lowest numbered section takes precedence and the operator shall not implement the later numbered and conflicting section.

OAR 629-625-0600 Road Maintenance

(1) The purpose of this rule is to protect water quality and ensure hydrologic disconnection of roads from waters of the state to the maximum extent practicable by timely maintenance of all active and inactive roads. Road surface must be maintained as necessary to:

- (a) Minimize erosion of the surface and the subgrade;
- (b) Minimize direct delivery of surface water to waters of the state;
- (c) Minimize sediment entry to waters of the state;
- (d) Direct any groundwater that is captured by the road surface onto stable portions of the forest floor;
- (e) Ensure properly functioning and durable drainage features; and
- (f) For existing roads with inboard ditch, avoid overcleaning of ditchlines.

Note: OAR 629-600-0100(71) "Hydrologic disconnection" means the removal of direct routes of drainage or overland flow of road runoff to waters of the state.

OAR 629-603-0200(3)(a)(C) The **objective** of the research;

1. To assess the current (baseline) and trend status of roads being hydrologically disconnected from streams.
2. Is the focus sediment (as in Dube et al. (2010) and Martin (2009)), more parameters, or just hydrologic disconnection?

OAR 629-603-0200(3)(a)(D) A **brief description of the context** of the research question;

The following direction was provided in the PFA Report (p. 67):

“4.3.10 Development of Monitoring Requirements

The Independent Research Science Team (IRST) created under the PFA shall design and oversee baseline and trend monitoring for hydrologic disconnection. Compliance monitoring will be conducted through the Department's process.

1. **Baseline and Trend Monitoring for Hydrologic Disconnection:** The methodology for the monitoring shall be based off of Dube et al. (2010) and Martin (2009). The purpose of the monitoring for hydrologic disconnection is to establish a baseline and to monitor and report the change in hydrologic connectivity over time as the

FRIA is implemented. The overarching goal is to ensure that all forest roads and landings shall be hydrologically disconnected to the maximum extent feasible from waters of the state. The Adaptive Management Program Committee shall use the results of the baseline and trend monitoring to develop regional goals consistent with that monitoring. All hydrologic connectivity data should be public and shared as it becomes available to help focus goals, identify accomplishments, and inform statewide learning.”

OAR 629-603-0200(3)(a)(E) **Other information** the AMPC deems necessary for the IRST’s work per section (4) of this rule.

- *Note that the intention is NOT to compare conditions or rules with previous rules.*
- *For the new rules, there are two regulatory regions, separated by the crest of the cascade mountains.*
- *Ideally, the baseline would be for the effective date for the road rules (Jan. 1, 2024); however, it will take time to refine and scope the research questions, decide on the research agenda, develop then award the RFP.*

From Wendy Gerlach

To me, it seems the topic requires the IRST to develop a baseline and trends monitoring. So the second two questions don’t seem integral to our task. Though perhaps there could be added the questions: 1. What are the “maximum extent practicable” practices for avoiding connectivity in each of these zones? 2. Applying the “maximum extent practicable” practices from Question 1, will these achieve the HCP species protection goals?

I think I would frame the rules this way if I were the drafter:

1. What is the appropriate baseline for hydrologic connectivity under the rules? Please provide details of baseline measured criteria, regions, and sample properties.
2. What are the practices that would meet the requirement of “maximum extent practicable” for each region? Please provide detail as to precipitation, soil, grade, and other characteristics of region and road context.
3. Would the practices identified in (2) above, when complied with, achieve the goals of the HCP?
4. What monitoring system will best measure and reflect trends over time, in order to assess achievement of the goals of the HCP? Please provide details as to data sources, staffing requirements, and landowner engagement, as well as a proposed measurement timeline.

As I’ve framed the questions, they relate to work product that the IRST is (I think) supposed to deliver. For future questions, I’d expect them to resemble traditional research questions more closely.

From Casey Kulla

I don't think the research question should ask operators what "maximum extent..." means, so much as provide that definition to the IRST and ask the Team to consider differences in practice by region/landowner scale and how those differences might be measured for effectiveness.

I would appreciate a component of the research to ask IRST what a good proxy measurement might be for hydrologic disconnection or connection (is sedimentation or turbidity or something else that can be measured remotely the best way to ID disconnection or ongoing connection)?

While you mention stratification by landowner type and region, I'd like to make sure those research components are directly-related to differences in OFPA rules; that is, let's make sure the research questions are connected to OARs, not just to types or regions.

From Julie Firman:

Research questions

5. What are the baseline and trends in hydrologic connectivity of roads per the relevant rules?
6. Several rules for hydrologic disconnection use the term "maximum extent practicable". When rules with this term are complied with, are they effective at achieving the goals of rules?
7. What is the current diversity of agency, operator, landowner, and other stakeholder understanding of "maximum extent practicable" with regards to hydrologic disconnection?

Commented [FT*O3]: Although this term is not defined in rule, it's better than "disconnection" which focuses on the ACT of removing connectivity, when we really want to know the status of connectivity

Questions for the IRST to help hone the Research Questions

6. What are some good approaches to stratify the aforementioned research questions regionally, considering:
 - a. The regions need to be relevant and practicable from a regulatory perspective [this aspect would be addressed in conversation with ODF subject matter experts];
 - b. Need the number of regions studied to be cost-effective (e.g., obviously couldn't have 100 regions, but probably more like 2-8 regions);
 - c. What are good "filters" with which to create regions within which there is a "reasonable" amount of similarity, e.g.,
 - i. Precipitation – quantity, type (rain- vs. snow-dominated)
 - ii. Geology
 - iii. Gradient or relief
 - iv. Ranges of protected species

Commented [FJ4]: I imagine that we'd want to define geology pretty coarsely for this purpose; i.e. resistant (granitic including basalt), vs. intermediate (sandstone) vs. weak (schists etc.), e.g. Hicks and Hall 2003, Rock type and channel gradient structure salmonid populations in the Oregon Coast Range and Firman et al. 2011, Landscape models of adult coho salmon density examined at four spatial extents. Trans. Am. Fish. Soc. 140(2): 440-455.

Commented [FJ5]: Gradient might be better to consider as a stratum than a region, since presumably there would be quite a bit of variability in gradient within any region we might define. We could categorize sites by gradient to allow comparison of different conditions. This might be true for geology as well.

Commented [FJ6]: This might be a stratum designation too since different species have different boundaries.

7. The road rules and FRIA will be implemented over the coming 20 years. Given this, what is a reasonable and cost-effective frequency to assess the trends in hydrologic disconnection? [E.g., every 3 years, 5 years, 7 years...]; note the importance of starting the data collection ASAP to have a solid baseline.
8. For study design on these research questions to look at trends over time, what are pros and cons of doing these in paired (i.e., revisiting same sites) vs. unpaired.
9. How best to stratify based on landowner type? Looking at two landowner types:
 - a. Small Forestland Owners per OAR 629-600-0100(126)
 - b. All other landowners subject to the FPA.

Commented [FJ7]: If we conducted the analysis every several years, I assume that we could still define annual statistics to determine trends. Three years is probably too short a time period to defensibly detect a trend given that you'd only have 2 or three data points to fit to a line. Five years sounds about right but that first assessment might still be a little wobbly.

Commented [FJ8]: I'd suggest a rotating panel design with differing rotation intervals for the different panels of sites. Each panel should be internally spatially balanced and representative of any strata that we establish. The rotation interval can be set depending on the interval at which we'd expect to be able to detect change. There might be one panel of sites that we visit every year to detect the effect of annual differences precipitation on performance (i.e. capture wet years and quantify how different the response is relative to dry years), another panel that only gets visited once (this would allow us to sample more of the sites), and possibly additional panels visited at longer repeat intervals (5 years, 10 years?)

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OAR 629-603-0100(1)(a) Conduct effectiveness monitoring by assessing the degree to which the rules facilitating particular forest conditions and ecological processes achieve the biological goals and objectives. This assessment may include evaluation of cumulative effects.

OAR 629-603-0100(1)(b) Conduct research inquiry and validation monitoring to:

- (A) Determine if additional scientific inquiry is needed to fill knowledge gaps related to biological goals and objectives; and
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OAR 629-603-0200(3)(a)(B) The **rules, biological goals and objectives, or other issues** being studied;

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OAR 629-625-0320 Water Crossing Structures;

(10) Construction of Water Crossings. In the construction of water crossings, operators shall do the following:

(b) Runoff, Erosion and Sediment. Operators shall control runoff, erosion, and sediment through the following actions:

(A) Include a site-specific erosion and sediment control plan as part of a written plan prior to beginning work. This plan must include, but is not limited to:

(i) A site plan with a description of the methods of erosion or sediment control;

Commented [FT*O9]: BGOs aren't finalized, so can't really link back to them. Are there other issues to be addressed, other than the rules listed?

Commented [FJ10]: Does fish passage post construction come in to play here? It looks like the rule only considers sediment. Perhaps OAR 629-603-0200(3)(a)(C) Section 2 opens up the possibility of monitoring passage as well.

- (ii) *Methods for confining, removing, and disposing of excess construction materials; and*
- (iii) *Measures to disconnect road surface and ditch water from all typed waters and lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, wetlands, inlets, and canals.*

OAR 629-625-0330 Drainage

(1) All active, inactive, and vacated forest roads and landings shall be hydrologically disconnected to the maximum extent practicable from waters of the state to minimize sediment delivery from road runoff and reduce the potential for hydrological changes that alter the magnitude and frequency of runoff. Operators shall locate drainage structures based on the priority listed below. When there is a conflict between the requirements of sections (2) through (7) of this rule, the lowest numbered section takes precedence and the operator shall not implement the later numbered and conflicting section.

Commented [FJ11]: Should we include the requirements of sections 2-7 here? I found myself looking for them.

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**Appendix 1. Primer on forming research question(s) for the research topic:
Requirements of baseline and trend monitoring of road rules**

Note: this primer is included in this document for ease, and is the version sent to the AMPC in August 2023.

The purpose of this document is to inform the AMPC’s development of research questions related to forest roads and to clearly articulate the direction to the AMPC and IRST as established under the Private Forest Accord (PFA) Report.

1. Distinguishing Research Topics from Research Questions

Research Topics	Research Questions
<p><u>Research topics</u> are a broad research theme either in rule (the three in OAR 629-603-0100(7)) or raised by an AMPC member for consideration to conduct research.</p> <p>Research topics will regularly be prioritized for 1) focusing on in the near term; and, 2) a “parking lot” to regularly revisit (e.g., annually or biennially) to assess if sufficient resources are available to address them in your prioritized order.</p> <p>EXAMPLE: “The impacts of timber harvest along nonfish streams on downstream, fish-bearing streams”</p>	<p><u>Research questions</u> are policy questions that the AMPC deems important to research, can be implemented in a research project, and are refinements of Research Topics.</p> <p>The FPA rules require specific elements when sending these questions to the IRST:</p> <p>OAR 629-603-0200 (3) Step 1: The AMPC shall develop preliminary research question(s).</p> <p>(a) The AMPC shall succinctly specify preliminary research questions that include the following:</p> <ul style="list-style-type: none"> (A) The type of research and monitoring per OAR 629-603-0100(1)(a) or (b); (B) The rule, biological goals and objectives, or other issue being studied; (C) The objective of the research; (D) A brief description of the context of the research question; and (E) Other information the AMPC deems necessary for the IRST’s work per section (4) of this rule. <p>(b) The board may direct the AMPC to develop additional preliminary research questions.</p> <p>(c) The AMPC shall send the preliminary research questions to the IRST annually on a date specified in the AMPC charter developed pursuant to OAR 629-603-0300(2).</p>

2. Configuration of a “Research Question” (Summarized from OAR 629-603-0200(3)(a))

According to the FPA, a “research question” developed by the AMPC must include the following components when it is sent to the IRST:

- The **type** of research and monitoring
- The **rule, biological goals and objectives, or other issue** being studied
- The **objective** of the research
- Brief discussion of the **context** of the research question
- **Other information** that AMPC deems necessary

3. Direction to AMPC and IRST from the PFA Report regarding the forest roads research topic

In Chapter 4, the PFA Report (p. 67) provides the following direction related to the IRST and AMPC:

“4.3.10 Development of Monitoring Requirements

The Independent Research Science Team (IRST) created under the PFA shall design and oversee baseline and trend monitoring for hydrologic disconnection. Compliance monitoring will be conducted through the Department’s process.

- 2. Baseline and Trend Monitoring for Hydrologic Disconnection:** *The methodology for the monitoring shall be based off of Dube et al. (2010) and Martin (2009). The purpose of the monitoring for hydrologic disconnection is to establish a baseline and to monitor and report the change in hydrologic connectivity over time as the FRIA is implemented. The overarching goal is to ensure that all forest roads and landings shall be hydrologically disconnected to the maximum extent feasible from waters of the state. The Adaptive Management Program Committee shall use the results of the baseline and trend monitoring to develop regional goals consistent with that monitoring. All hydrologic connectivity data should be public and shared as it becomes available to help focus goals, identify accomplishments, and inform statewide learning.”*

Key components of this provision of the PFA Report include:

- **IRST Role:**
 - *“IRST...shall design and oversee baseline and trend monitoring for hydrologic disconnection.”*
- **Methodology:**
 - *“The methodology for the monitoring shall be based off of Dube et al. (2010) and Martin (2009).”*
- **Purpose of baseline and trend monitoring:**
 - *“The purpose of the monitoring for hydrologic disconnection is to establish a baseline and to monitor and report the change in hydrologic connectivity over time as the FRIA is implemented.*
- **AMPC role:**
 - *“The Adaptive Management Program Committee shall use the results of the baseline and trend monitoring to develop regional goals consistent with that monitoring.”*

4. Examples of questions from Dubé et al. (2010)

The following research questions, from Dube et al. (2010), provide examples to spur the AMPC members’ thinking.

Monitoring Question 1: What is the condition of forest roads at each sample event, specifically those attributes management can change relative to sediment production and delivery?

Monitoring Question 2: Have road attributes that affect sediment production and delivery improved over time?

- Hypothesis 2a: No reduction in road drainage connectivity to streams has occurred since the previous sampling event(s).
- Hypothesis 2b: No improvement in road attributes that affect sediment production and delivery has occurred since the previous sampling event(s).

Monitoring Question 3: What is the status of road performance measures for drainage connectivity and sediment delivery to streams at each sample event?

Monitoring Question 4: What is the status of road performance measures relative to their targets, by performance target region, at each sample event?

Monitoring Question 5: Have measures of road sediment performance improved over time?

- Hypothesis 5a: No reduction in the road drainage connectivity performance measure has occurred since the previous sampling event(s).
- Hypothesis 5b: No reduction in the road sediment delivery performance measure has occurred since the previous sampling event(s).

Monitoring Question 6: Will roads judged to meet FFR road standards meet the performance targets?

- Hypothesis 6a: There is no direct relationship between the percentage of the road system that is judged to meet road standards and the reported road drainage connectivity performance measures.
- Hypothesis 6b: There is no direct relationship between the percentage of the road system that is judged to meet road standards and the reported road sediment delivery performance measures.

5. Discussion Questions for AMPC to Consider

The following questions are intended to help the AMPC members think through developing the research question(s). Note that the AMPC may request additional input from the IRST to address any or all these considerations.

1. Based on the constraints and focus established in the PFA Report, what is the decision space to develop a research question(s)?
2. Elements to consider in the discussion include:
 - a. Scope and scale of the research
 - b. Time and spatial scale of the research
 - c. Outcomes of the research (e.g., regional specificity, high confidence)
 - d. Specific parameters (e.g., suspended sediment, hydrologic disconnection)
3. What does the AMPC think about requesting several different scoping studies from the IRST that vary based on rigor, spatial and temporal scales, confidence in results, number of parameters, etc.?

References

Dubé, K., A. Shelly, J. Black, and K. Kuzis. 2010. *Washington road sub-basin scale effectiveness monitoring first sampling event (2006-2008) report*. Cooperative Monitoring, Evaluation and Research Report CMER 08-801. Washington Department of Natural Resources. Olympia, Washington.

Martin, D. 2009. *Forest road runoff disconnection survey for private timberlands in Washington*. Olympia, WA: Washington Forest Protection Association.

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