Subject: FW: Follow-up on Soil Nitrate Testing and A/R vs A-R Discussion
Date: Friday, October 31, 2025 at 11:18:06 AM Pacific Daylight Time
From: STAPLETON Isaak * ODA <Isaak.STAPLETON@oda.oregon.gov>
To: SUMMERS Sunny * ODA <Sunny.SUMMERS@oda.oregon.gov>
Attachments: image001.png

Sunny,
Here are additional comments received from OSU for the LUB rules.

Isaak Stapleton, Division Director
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Pronouns: he/him

From: Moore, Amber D <amber.moore@oregonstate.edu>
Date: Tuesday, October 21, 2025 at 3:01 PM
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Subject: Follow-up on Soil Nitrate Testing and A/R vs A-R Discussion

Hi Isaak,

Thank you for the opportunity to continue our discussion about the potential use of fall soil nitrate testing and the comparative approaches of A/R (Applied ÷ Removed) and A-R (Applied – Removed) within the context of the LUBGWMA rulemaking. I wanted to provide a written summary of my concerns and perspectives to help inform the next phase of your deliberations.

1. Concerns with Fall Soil Nitrate Testing as a Grower Evaluation Tool
Based on both the scientific literature and regional experience (including data from British Columbia, Washington's CAFO permit implementation, and published studies by Geisseler and colleagues), there are substantial limitations to using fall soil nitrate levels as a compliance or performance metric.

a. High Climate and Irrigation Sensitivity

- Precipitation and irrigation patterns strongly influence soil nitrate accumulation, making results highly variable year-to-year and across regions.
- Data from British Columbia and Washington indicate that wet (≥ 25 in) versus dry (< 25 in) precipitation zones behave fundamentally differently with respect to nitrate carryover and leaching potential.

- In dry, cold regions such as Hullcar Valley (BC), post-harvest nitrate tests showed no correlation with groundwater nitrate levels — meaning the test failed to predict leaching risk (Andrews 2023; Brandes & Nowlan 2017).
- Timing relative to rainfall or irrigation events can drastically change results; sampling before versus after a storm can yield opposite conclusions (Lazicki & Geisseler 2018).

b. Management Practices Confound Results
- Over-irrigators may appear compliant (low residual N due to leaching) even when actual leaching risk is high.
- Conversely, careful irrigators or growers in dry areas may appear "non-compliant" simply because nitrate remains in the soil profile.
- Crop sequence effects (e.g., wheat following potatoes) add further complexity; high residual nitrate may reflect rotation dynamics rather than poor management.
- Five-year before-and-after comparisons are unreliable when rotations change crop rooting depth or nitrogen demand.

c. Sampling Practicality and Representativeness
- The proposed 5-foot sampling depth and number of required cores are impractical for commercial operations.
- Within-field variability in nitrate distribution is extremely high, meaning representative sampling would require research-level intensity and cost — not feasible for regulatory enforcement or grower self-assessment (Carey et al. 2017).

d. Limited Scientific Correlation with Groundwater Quality
- Multiple peer-reviewed sources confirm that post-harvest soil nitrate concentration does not directly measure nitrate leaching risk or groundwater impact (Carey et al. 2017; Lazicki & Geisseler 2018).
- The Hullcar Valley study concluded explicitly that PHNT "does not measure the risk of nitrate leaching." (Andrews 2023; Brandes & Nowlan 2017).
- While post-harvest nitrate tests can be useful in research for relative treatment comparisons, they are not sufficiently reliable or interpretable as regulatory indicators of groundwater protection.

Taken together, these findings suggest that soil nitrate testing may not provide the accuracy, reproducibility, or fairness needed for either grower evaluation or regulatory compliance.

2. A/R vs A-R: Alignment with ODA's Intent and Regulatory Goals

California's programs provide a strong example of how nitrogen management metrics can be aligned with both agronomic efficiency and environmental outcomes.
- In the Central Valley, grower coalitions adopted A/R (Applied ÷ Removed) as the *primary performance metric* for benchmarking nitrogen-use efficiency. They established crop-specific, multi-year acceptable ranges for A/R that reflect both agronomic and environmental performance, and update them periodically as new data emerge.
- In contrast, the Central Coast (Ag Order 4.0) program uses A-R (Applied – Removed) for regulatory discharge limits—but this approach has proven challenging to implement, requiring decades of phased reduction schedules and providing less context for efficiency improvements.
- Both metrics quantify aspects of the nitrogen cycle, but A/R more directly supports adaptive management and performance tracking.
    - A/R = Efficiency: Shows how effectively applied nitrogen is converted into harvested yield.
    - A-R = Surplus: Represents the total nitrogen mass remaining in the system but provides little insight into relative efficiency or year-to-year progress.

For Oregon, adopting A/R as the primary metric would align with California's science-based performance framework and emphasize continuous improvement over fixed numeric discharge

limits. It allows benchmarking across crops and operations while promoting a shared language around efficiency and stewardship.

3. Limitations and Resource Needs for Implementing A/R in Oregon
Unlike California, Oregon currently lacks the foundational infrastructure needed to calculate and interpret A/R values with scientific confidence. Specifically:

1. No Established Nitrogen Removal Coefficients.
   California's system relies on years of University of California research defining N-removal coefficients for each crop (harvest + perennial sequestration). Oregon does not yet have equivalent coefficients for LUBGWMA crops such as potatoes, triticale, corn silage, wheat, alfalfa, or grass seed.
2. Extensive Data Collection Required.
   Developing coefficients would require multi-year, multi-site sampling of yield, tissue N, and harvest removal across climate zones and irrigation systems.
3. Significant Funding, Labor, and Travel Needs.
   Fieldwork across the Lower Umatilla Basin would involve intensive coordination, sample collection, lab analysis, and data management — easily representing several hundred thousand dollars in labor, mileage, analytical, and personnel costs.
4. Collaboration and Leadership Across Institutions.
   OSU, ODA, DEQ, NRCS, commodity commissions, and growers would need to jointly design protocols, QA/QC systems, and data-sharing agreements — a multi-year process requiring stable funding and staff continuity.
5. Scientific Expertise for Range Development.
   Once coefficients exist, ODA would still need to establish "acceptable ranges" for A/R (lower and upper bounds by crop and region) through rigorous statistical analysis and expert review. That process alone took California several years and multiple expert panels.

In short, A/R is the most scientifically defensible and policy-aligned metric, but it must be built on credible Oregon data and shared institutional leadership. Premature adoption of A-R as a regulatory standard would risk repeating early implementation challenges seen in California's Central Coast program and would not advance the state toward true performance-based management.

Suggested Next Steps for A/R

- Treat A/R as the long-term framework for evaluating nitrogen-use efficiency in Oregon, modeled after the California Central Valley approach.
- Develop a multi-year, collaborative effort (ODA + OSU + commodity commissions + NRCS) to generate Oregon-specific N-removal coefficients.
- Support funding proposals to build this dataset and technical foundation.
- Defer incorporation of any numeric A/R targets into rule language until coefficients and acceptable ranges are established.

I appreciate ODA's thoughtful attention to these discussions and the agency's continued effort to align groundwater-protection goals with agronomic science. Thank you for engaging so collaboratively on these complex topics.

Best regards,
Amber D. Moore
Extension Soil Fertility Specialist & Associate Professor
Oregon State University

References

- Andrews, J. (2023). *Soil Nitrate Survey of Agricultural Fields in the Hullcar Valley in 2022.* BC Ministry of Agriculture and Food. Link
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- Brandes, O. M., & Nowlan, L. (2017). *From Crisis to Solutions: Towards Improved Source Water Protection and Nutrient Management in the Hullcar Valley.* POLIS Project, University of Victoria. Link
- Carey, B. M., Pitz, C. F., & Harrison, J. H. (2017). *Field nitrogen budgets and post-harvest soil nitrate as indicators of N leaching to groundwater in a Pacific Northwest dairy grass field.* Nutrient Cycling in Agroecosystems, 107, 107–123.
- Formation Environmental, LLC. (2024). *Crop-Specific Multi-Year Acceptable Ranges of Applied Nitrogen Relative to Nitrogen Removed.* Prepared for Central Valley Water Quality Coalitions, October 2024. Link
- Geisseler, D. (2016). *Nitrogen Concentrations in Harvested Plant Parts – A Literature Overview.* California Department of Food and Agriculture FREP Report.
- Lazicki, P. A., & Geisseler, D. (2018). *Soil nitrate testing supports nitrogen management in irrigated annual crops.* California Agriculture, 71(2).

From: STAPLETON Isaak * ODA <Isaak.STAPLETON@oda.oregon.gov>
Sent: Tuesday, October 21, 2025 1:21 PM
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Subject: Re: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

I think we would like to continue the conversation we had with Carlos last week to better understand the comments regarding the use of fall soils samples as a grower evaluation and planning tool as well as discuss the A/R vs A-R option and how they align with the agencies intent of the rules.

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Subject: RE: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

Hi Isaak,

Thanks for organizing this. Could you give us a quick sense of what you'd like to focus on or what ODA is hoping to accomplish in the meeting? That'll help us come ready to contribute effectively.

Thanks,
Amber

From: STAPLETON Isaak * ODA <Isaak.STAPLETON@oda.oregon.gov>
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Subject: Re: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

Carlos,
Is there a time that works for your whole team between now and next Tuesday? It would be great if we could get everyone together prior to the draft rules going out for public comment. If you give me a few times I will see if I can rearrange my calendar to make it happen. In order for us to meet out timeline we will need to have them finalized by end of day Wednesday 10/29.

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Subject: Re: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

Hi Isaak,

Friday 1:30 to 2:30 work for this week. Next week Tuesday I have some availability.

Thank you,
Salini

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Please note: My response time reflects my personal working schedule. There's no expectation for a reply outside of your regular working hours. Thank you for your understanding.

Oregon State University

From: Moore, Amber D <amber.moore@oregonstate.edu>
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Subject: Re: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

Hi Isaak,

I'm available most of next week.

Amber

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From: STAPLETON Isaak * ODA <Isaak.STAPLETON@oda.oregon.gov>
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Subject: Re: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

Hi Carlos,

I am just following up after our discussion last Thursday to find a time for a meeting with the whole OSU team. It looks like the ODA team is available Thursday between 1:00 and 3:30, or Friday 1:30 to 2:30. Let me know if any of those times work, if not we will try and find some additional time slots.

Thank you,

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Subject: Clarification on Nitrogen Balance and Methodology Language in RAC Draft

Hi Isaak,

Thank you for sharing the most recent draft of the RAC materials and for the opportunity to provide input ahead of Thursday's meeting. After reviewing the section on nitrogen balance and nutrient budgeting, several points of clarification from the OSU team may help ensure the language accurately reflects our previous discussions and scientific intent.

First, the current text attributes to OSU the recommendation of the **A–R (applied minus removed)** approach for estimating post-harvest soil nitrate storage. In fact, our working group recommended the **A/R (applied divided by removed)** ratio approach, which is conceptually and mathematically different. The A–R method can easily be misinterpreted as a direct measure of soil nitrate accumulation, which was not our intent. Clarifying this distinction would better align the document with the group's prior discussions and the supporting literature.

Relatedly, the comment that "i*t is hoped that OSU will be able to develop a calculator and nitrogen coefficients for crops in the LUBGWMA*" may unintentionally imply a formal commitment from OSU. While we are glad to support the technical process as capacity allows, OSU has not committed to developing such a tool at this stage.

We also noticed several areas where the language could benefit from refinement or clarification:

- Nitrogen Form: The text continues to reference total N rather than plant-available N, particularly in the nutrient budgeting section. Using plant-available N would be more consistent with agronomic practice and the scientific intent of the balance approach.
- Agronomic Rate: The current draft implies a single "agronomic rate," though rates are typically expressed as recommended ranges that vary with site, yield goals, and conditions. They are designed for optimizing yield, not directly for minimizing leaching.
- Soil Testing for Nitrate: The continued emphasis on routine soil nitrate testing is concerning. Unlike phosphorus, nitrate levels fluctuate rapidly and are not reliable indicators of nitrogen loading risk outside of CAFO or controlled settings. OSU's earlier feedback recommended focusing instead on nitrogen additions and removals.

- Organic Amendments: The omission of manure, compost, and reused water nutrients may lead to incomplete accounting of N sources. Clarification on whether these are addressed under separate rulemaking would be helpful.

We share ODA's goal of developing a workable, science-based framework that helps producers manage nutrients effectively while protecting water quality. These refinements are offered in that spirit, to help ensure the rule language aligns with sound agronomic principles and the shared intent of the RAC.
Please don't hesitate to reach out if you'd like additional clarification or examples before the meeting.
Best regards
Carlos

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