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Washington State Department of Ecology

Climate Pollution Reduction Program

Attn: Carbon Capture, Removal, Utilization, and Storage Comment Period

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Re: Public Comment on Carbon Capture, Removal, Utilization, and Storage in the Cap-and-Invest Program (Comment Period: May 21 – June 26, 2026)

Dear Department of Ecology Carbon Management Team:

Grassroots Carbon appreciates the opportunity to comment on Ecology's effort to clarify how carbon management fits within the Cap-and-Invest Program. We are a Public Benefit LLC that pays U.S. ranchers, including in Washington State, to draw atmospheric CO_2 into rangeland soils through measurement-based, third-party-verified soil organic carbon (SOC) storage. We have delivered soil carbon storage credits to integrity-focused buyers including Boeing and Microsoft. Our credits are quantified through measure-to-measure soil core sampling to 1 meter of depth, re-sampled on a five-year cycle, modeled in intervening years against measured true-ups, and secured by a buffer pool of credits held back at issuance.

Our comment is organized around two practical recommendations for Ecology, either or both of which would meaningfully advance the program:

- **Primary recommendation:** Issue clarifying guidance under WAC 173-407-110 recognizing that, on rigorous measurement-based protocols, the stabilization of soil organic carbon as deep-soil *mineral-associated organic carbon (MAOC)* qualifies as "conversion into a long-lived mineral form" for purposes of the WAC 173-446-040(2)(a) emissions exemption.
- **Secondary recommendation:** Develop or adopt a Washington-applicable compliance offset protocol for soil carbon under WAC 173-446-500 through 173-446-595, structured on the same integrity criteria Ecology already applies to its other protocols.

These recommendations are independent. The primary one is rooted in soil science the regulatory text leaves room for; the secondary one is rooted in the existing offset architecture of Chapter 173-446 WAC.

Summary of Grassroots Carbon's Positions

- WAC 173-407-110 does not define "mineral form," and the regulatory text leaves that determination to Ecology. The peer-reviewed soil-science literature treats MAOC as a chemically and physically stabilized organo-mineral pool with mean residence times of centuries to millennia (Kleber et al., 2015; Lavallee, Soong & Cotrufo, 2020). Ecology can credibly interpret "conversion into a long-lived mineral form" to include measurement-based deep-soil MAOC under defined safeguards.
- Recognition should be conditional and rigorous, not blanket. Not all soil carbon, and not all MAOC, supports a 1,000-year / 99% retention finding. The guidance we propose limits recognition to deep-soil MAOC.
- Independent of the exemption pathway, Ecology should preserve and develop the offset pathway. The 1,000-year / 99% standard at WAC 173-407-110 gates the WAC 173-446-040(2)(a) exemption; it does not and should not displace the integrity criteria internal to the offset protocols at WAC 173-446-500 through 173-446-595. Reading it more broadly would foreclose the forest, urban forest, and livestock protocols Ecology has already adopted.
- A portfolio approach — engineered point-source CCS where it fits, mineralization where geology supports it, and measurement-based biological removals on Washington's working lands — is more aligned with the CCA's statutory direction (including RCW 70A.65.170(4)(b) and the "best available science" standard) than any single-pathway approach.
- Soil carbon projects have a materially lower community and Tribal harm profile than CO_2 pipelines, injection wells, and capture retrofits because they require no new heavy infrastructure.

A Pathway Forward: Clarifying Guidance on MAOC as Conversion into Long-Lived Mineral Form

Feedback Area 3 asks whether existing approaches meet the WAC 173-407-110 definition of permanent sequestration and whether that definition creates barriers. We address both below, and propose specific clarifying-guidance language Ecology could adopt.

The interpretive question Ecology faces

WAC 173-407-110 defines permanent sequestration as "the retention of greenhouse gases in a containment system using a method that is in accordance with standards approved by ecology and that creates a high degree of confidence that substantially ninety-nine percent of the greenhouse gases will remain contained for at least one thousand years." WAC 173-446-040(2)(a) operationalizes this for the emissions exemption by referring to "long-term geologic sequestration or … conversion into long-lived mineral form."

Critically, neither rule defines "mineral form," "containment system," or the "standards approved by ecology" referenced in the rule. These are matters Ecology has explicit authority and responsibility to interpret. We respectfully submit that the soundest interpretation — supported by current soil science

and consistent with the rule's plain text — recognizes measurement-based deep-soil MAOC as a qualifying form, under defined safeguards.

The scientific case for MAOC as a long-lived mineral form

Soil organic carbon exists along a continuum from free particulate matter to fully mineral-bound organo-mineral complexes. Modern soil science distinguishes two operationally defined fractions: Particulate organic matter (POM), composed of fragmented plant tissues with residence times typically measured in years to decades; and Mineral-associated organic carbon (MAOC), microbially processed carbon chemically and physically bound to silt, clay, and reactive iron/aluminum mineral surfaces. MAOC can persist in soil for centuries to millennia (Kleber et al., 2015; Lavallee et al., 2020; Torn et al., 1997).

Three features of MAOC are directly relevant to the WAC 173-407-110 inquiry:

- **Functional conversion to mineral-bound form.** MAOC is not free organic carbon adjacent to minerals; it is carbon bonded to mineral surfaces through ligand exchange, cation bridging, hydrophobic interactions, and entrapment within microaggregates. The carbon is functionally inseparable from the mineral matrix without dissolving the mineral itself. In soil-science terms, MAOC is the operationally defined "mineral-stabilized" fraction of soil organic carbon.
- **Containment system.** The mineral matrix functions as a containment system in the sense the rule contemplates: it physically restricts microbial and enzymatic access to the carbon, limits oxygen diffusion, and chemically restricts desorption. These are the same containment functions a cap rock provides in a Class VI context, accomplished by a different mechanism at smaller spatial scales.
- **Millennial-scale persistence in deep soils.** Radiocarbon-based mean residence time studies consistently find MAOC persistence on the order of centuries to millennia, with deep-soil and fine-textured-soil MAOC at the longer end of that range (Torn et al., 1997; Schmidt et al., 2011; Kleber et al., 2015). In suitable systems, the 1,000-year threshold at WAC 173-407-110 is empirically supportable.

Honest caveats Ecology should know about

We do not ask Ecology to recognize "soil carbon" generally. That would be an overclaim, and the recent literature is explicit about the limits:

- Not all MAOC is millennial. The long-lived component is concentrated in deep soils, in fine-textured soils with abundant clay and reactive mineral surfaces, and in microbially-processed MAOC.
- Shallow soil carbon is more vulnerable to reversal through tillage, land-use change, and disturbance. The 1,000-year case is strongest for MAOC measured below the surface tillage horizon (typically below 30 cm).

- POM, by contrast, is generally not a candidate for the "long-lived mineral form" pathway and should not be claimed as such.

These caveats are why the guidance we propose below is conditional and limited — recognition of a defined, measured fraction of soil carbon under specified safeguards, not a blanket approval.

Proposed clarifying guidance language

We respectfully suggest Ecology could issue clarifying guidance, by rulemaking or interpretive bulletin, along the following lines. We do not propose any change to the WAC 173-407-110 definition itself; we propose only that Ecology interpret existing terms in a way the science supports:

> *Soil organic carbon stock increases qualify as conversion into a long-lived mineral form under WAC 173-446-040(2)(a) and WAC 173-407-110 to the extent that the project demonstrates each of the following to Ecology's satisfaction: (a) the credited carbon is in the mineral-associated organic carbon (MAOC) fraction, as confirmed by validated physical or chemical soil fractionation; (b) the credited carbon is located in mineral soil below the surface tillage horizon, and in any case at a sampling depth of at least 30 centimeters; (c) the soil profile has sufficient fine-mineral (clay plus fine silt) content to support long-term MAOC stabilization, as established by site-level analysis against a threshold approved by Ecology; (d) stock changes are quantified by direct, statistically defensible measurement using Equivalent Soil Mass accounting, not by modeling alone, with re-measurement. Stock changes not meeting these conditions may be eligible for offset credits under WAC 173-446-500 et seq. but do not qualify for the WAC 173-446-040(2)(a) emissions exemption.*

This formulation accomplishes three things at once. It gives Ecology a defensible, narrow, rigorous interpretation grounded in current soil science. It does not require any amendment to existing rule text. And it preserves the offset pathway as the appropriate compliance avenue for soil carbon that does not meet the heightened MAOC-specific criteria.

Feedback Area 1: Carbon Management Within the Cap-and-Invest Program

Question 1: Which engineered carbon management pathways present the greatest opportunity for Cap-and-Invest Program compliance? Why?

The most useful framing is not "which single pathway" but "which portfolio delivers verified, near-term Washington tons with the lowest risk of community harm and the strongest co-benefits."

Measurement-based soil carbon removal should be evaluated alongside engineered technologies on its own merits because it is deployable at scale today, delivers Washington-relevant co-benefits on working lands (resilience, water retention, biodiversity, rural and Tribal economic activity), and has project timelines measured in months rather than the years to decades typical of large engineered facilities.

Question 3: Specific questions on treatment under the program.

We have one: will Ecology treat the WAC 173-407-110 “permanent sequestration” definition as a gating threshold for offset eligibility under the WAC 173-446-500 series, or will offsets continue to be governed by the integrity criteria internal to each adopted compliance offset protocol (additionality, real, quantifiable, verifiable, enforceable, permanent within the protocol’s storage term, and direct environmental benefit to Washington)? We urge the latter, which is consistent with Ecology’s own existing protocols and with the practice of every functioning compliance market.

Feedback Area 2: Carbon Management in Washington

Question 4: Are engineered carbon management pathways feasible for Washington facilities? Timelines?

Measurement-based soil carbon can begin generating verified, retired tons within 12–36 months of project enrollment. For Washington specifically, eastern Washington’s rangelands, dryland pasture, and grazed shrub-steppe systems are well-suited to deep-soil MAOC accrual on rigorous protocols. A Washington-applicable framework — either through the MAOC-recognition guidance we propose, or through a soil carbon offset protocol, or both — could begin delivering tons during the current compliance period.

Question 5: Greatest obstacles to implementing engineered carbon management in Washington, and how the state can remove barriers.

For measurement-based soil carbon, the largest barriers in Washington are interpretive (the absence of clarifying guidance under WAC 173-407-110, which is what we propose above) and protocol-architectural (the absence of a Washington-applicable soil carbon compliance offset protocol). Both barriers are within Ecology’s authority to remove without legislative action.

Question 6: Potential impacts or harms on communities and Tribes.

Measurement-based soil carbon projects do not require new pipelines, injection wells, captured-CO_2 transport, or fixed industrial infrastructure. The project footprint is the working land already in production. Soil carbon projects also deliver positive externalities to rural and Tribal agricultural communities (revenue, soil health, water retention, biodiversity) that engineered pathways generally do not.

Feedback Area 3: Implementation of the CCA Program Rule

Our principal response to this Feedback Area is the proposed clarifying-guidance language set out earlier in this letter. The question-specific responses below supplement that framing.

Question 7: Which sequestration and/or mineralization approaches might meet the WAC 173-407-110 definition? Approaches unlikely to meet it?

Subject to the safeguards set out earlier, MAOC is functionally a mineral-stabilized form, the mineral matrix functions as a containment system, and deep-soil MAOC in suitable soils supports the 1,000-year retention threshold.

Question 8: Does this definition create barriers? How and why?

Read narrowly — as governing only the exemption at WAC 173-446-040(2)(a) — the definition does not create undue barriers. It correctly sets a high bar for an unusual privilege.

The barrier problem arises in two specific ways. First, the absence of clarifying guidance on what "conversion into a long-lived mineral form" includes leaves an entire scientifically defensible pathway — deep-soil MAOC — in interpretive limbo, with no developer willing to invest in projects whose regulatory eligibility is unresolved. Issuing the guidance we propose above removes that barrier without amending the rule.

Second, if Ecology or program participants begin reading the WAC 173-407-110 definition as the standard for all carbon-management participation in the program (offsets included), it would foreclose every biological pathway, including the forest, urban forest, and livestock offset protocols Ecology has already adopted. That reading would conflict with the structure of WAC 173-446 itself and with the CCA's direction to use the best available science. We urge Ecology, in any guidance it issues, to state expressly that the WAC 173-407-110 definition governs the WAC 173-446-040(2)(a) exemption and does not displace the integrity criteria in WAC 173-446-500 et seq. for offset credits.

Question 9: Monitoring and verification, risk mitigation, compensation, financial assurance, and reversal provisions.

Ecology has mature models to draw on. For offsets, the four adopted compliance protocols (including the updated Ozone Depleting Substances protocol that took effect on August 21, 2025, and the U.S. Forest protocol revisions currently in active rulemaking with an intended adoption date of June 10, 2026) provide a workable template for third-party verification on a defined schedule, reversal accounting, buffer-pool contributions calibrated to project risk, invalidation provisions under WAC 173-446-580, and project-operator registration under WAC 173-446-520. A soil carbon protocol — and an MAOC-recognition guidance — would map cleanly onto this structure.

Specific MRV elements we recommend for any soil-carbon-applicable framework Ecology develops:

- Direct, measured soil sampling rather than modeled-only quantification. Grassroots Carbon samples to 1 meter of depth at project initiation and on a five-year re-measurement cycle. Sampling to at least 1 meter where geology permits captures the deep MAOC pool where the durability case is strongest. Modeled estimates in intervening years are acceptable provided they are trued up to measured stocks at re-measurement.
- Validated soil fractionation methodology where exemption-pathway recognition (MAOC) is claimed, distinguishing the MAOC fraction from POM.

- Statistically defensible stratification and sampling density per project area.
- Buffer-pool contributions sized to project-specific reversal risk, with mandatory replacement for any reversal.

Question 11: What other methodologies or protocols should Ecology examine?

For the offset pathway, Ecology should examine, at a minimum:

- Climate Action Reserve Soil Enrichment Protocol (v1.1) — active U.S. compliance-grade protocol with reversal and buffer-pool provisions.

Strategies to mitigate impacts to communities and Tribes (Questions 12 and 13)

Practical strategies that have worked elsewhere and would translate to Washington:

- Pre-protocol Tribal consultation: invite Tribal Nations to co-design protocol elements that touch land tenure, water, and cultural resources, rather than consulting only at the project-permitting stage.

Closing

Grassroots Carbon supports Ecology's effort to bring clarity to the role of carbon management in the Cap-and-Invest Program. The science of soil organic carbon stabilization has advanced substantially in the last decade, and that science supports a narrow, defensible interpretive path under WAC 173-407-110 — recognition of measurement-based deep-soil MAOC as a long-lived mineral form, under the conditional safeguards set out in our proposed guidance language. Alongside that pathway, a Washington-applicable soil carbon compliance offset protocol would provide a parallel and complementary compliance avenue for the broader population of soil carbon projects.

We would welcome the opportunity to share more detail on our measurement-based methodology, to walk through the underlying soil science with Ecology's technical staff, to discuss the rangeland and pasture opportunity in Washington, and to support Ecology's development of either or both of these pathways. Thank you for the opportunity to comment.

Respectfully submitted,

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