

Verification Report

For Isometric

CDR Supplier	Planetary Technologies
CDR Pathway	Ocean Alkalinity Enhancement
Project	Nova Scotia Mineral OAE
Location	Tufts Cove Generating Station 315 Windmill Rd Dartmouth, Nova Scotia 44.674946, -63.595478
Verifiers	350Solutions
Reporting Period	April 1, 2025 – August 26, 2025
Net CDR	1189.65t
Report Date	September 30, 2025
Version	V1.2

Contents

List of Tables.....	4
List of Figures	4
Acronym and Chemical Definitions.....	4
1. Verification Summary.....	5
2. Verification Details	6
2.1. Objectives	6
2.2. Responsibilities	6
2.3. Level of Assurance & Materiality	7
2.4. Validation and Verification Body details	7
2.5. Approach	7
3. Technical Aspects.....	8
3.1. Project Description	8
3.2. Protocols and Modules Applied	9
3.3. Project Boundary	10
3.4. Changes since Validation and Previous Verification(s)	11
3.4.1. Quantification changes.....	11
3.4.2. Mooring Sensors	11
3.4.3. Interpretation of Permit Monitoring Requirements.....	11
3.4.4. Stop-Trigger Framework Exceedances and Changes	12
3.4.5. Calculation method for determining EQOH.....	12
3.4.6. Monitoring Station Changes	12
3.4.7. Minor PDD updates.....	13
3.4.8. Minor LCA change.....	13
3.4.9. Minor Modeling Approach Changes	13
4. Crediting Details	14
4.1. Reporting Period	14
4.2. Crediting Period.....	14
5. Validation and Verification Summary	14
5.1. Accuracy of the Statement	14
5.2. Validation and Verification Opinion	15
5.3. Summary of Validation and Verification Findings.....	16
5.4. Monitoring Requirements.....	17

5.5. Verification Limitations	18
6. Revision History	19
7. References	19
Appendix 1: Log of Findings	20
Appendix 2: CDR by Dosing Period	27
Appendix 3: Files Reviewed	29
Appendix 4: Verifier Qualifications	37

List of Tables

Table 1. Verification Summary	5
Table 2. Verified Total Removals by Planetary for Reporting Period Ending August 26, 2025.....	6
Table 3. Validation and Verification Activities	7
Table 4. GHG Sources, Sinks, and Reservoirs	10
Table 5. Net CDR Calculation for the Reporting Period from April 1, 2025 to August 26, 2025	15
Table 6. Eligibility criteria for Isometric's Standard, protocol, and modules relevant to Nova Scotia Mineral OAE.....	16
Table 7. Monitoring Requirements	17

List of Figures

Figure 1. Overview of Planetary Process at Tufts Cove. Beginning on October 15, 2024, feedstock was dispensed directly into the mixing tank, rather than using the Supersax 1500. Credit: Planetary	9
Figure 2. a) Original PDD monitoring stations and b) changes to monitoring stations introduced in TC25.1. Credit: Planetary	13

Acronym and Chemical Definitions

CDR	Carbon dioxide removal
CO₂	Carbon dioxide
CO₂e	Carbon dioxide equivalents
CO₃²⁻	Carbonate ion
DIC	Dissolved inorganic carbon
ECCO	Estimating the circulation and climate of the ocean (far-field model)
FAR	Forward action request
GHG	Greenhouse gas
GLEC	Global logistics emissions council
H₂CO₃	Carbonic acid
HCO₃⁻	Bicarbonate ion
MgCO₃	Magnesium carbonate
MgO	Magnesium oxide
NS-ECC	Nova Scotia Department of Environment and Climate Change
OAE	Ocean alkalinity enhancement
PDD	Project design document
ROMS	Regional ocean modeling system (near-field model)
S	Salinity
SSR	Sources, sinks, and reservoirs of greenhouse gasses
T	Temperature
TA	Total alkalinity
TSS	Total suspended solids

ISOMETRIC STANDARD VERIFICATION REPORT

Company: Planetary Technologies	Company Contact: Will Burt*	VVB: 350 Solutions Zoe Sandwith* Lily Schacht
Removal Method: Ocean Alkalinity Enhancement (OAE)		
Report Date: September 30, 2025		
Document No: 350-IS2516-VR1		
Revision: V1.2		

*primary contact/lead author

1. Verification Summary

Table 1. Verification Summary

Project Proponent	Planetary Technologies
Other Project Participants	None
Project Name	Nova Scotia Mineral OAE
Isometric Project Code	F5X7
Removal Method	Ocean Alkalinity Enhancement
Legal Ownership of CDR	Planetary Technologies
Crediting Period	February 1, 2024 – January 31, 2029
Reporting Period	April 1, 2025 – August 26, 2025
Greenhouse Gas Statement ID	gss_1K6BAA5RD1S0FEZE
Report Date	September 30, 2025
Net Carbon Dioxide Removal	1189.65
Project Location	Tufts Cove Generating Station 315 Windmill Rd Dartmouth, Nova Scotia 44.674946, -63.595478
Audit Type	Isometric Standard Verification in accordance with the following standard, protocol, and modules: Isometric Standard V1.7 Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 Dissolved Inorganic Carbon Storage in Oceans V1.0 Air-Sea CO ₂ Uptake V1.0 Energy Use Accounting V1.2 Transportation Emissions Accounting V1.1 Embodied Emissions Accounting V1.0 Rock and Mineral Feedstock Characterization V1.1

Isometric contracted 350Solutions to perform a project verification of the greenhouse gas (GHG) statement of Planetary Technologies' Nova Scotia Mineral Ocean Alkalinity Enhancement (OAE) for the reporting period April 1, 2025 – August 26, 2025. The alkalinity addition for this reporting period occurred February 1, 2025 – June 30, 2025, referred to as TC25.1. The GHG statement is based on crediting of air-sea CO₂ uptake modeled as a result of the activities of TC25.1 until August 26, 2025.

In addition, this GHG statement includes continuing air-sea CO₂ uptake caused by the alkalinity dosed February 1, 2024 – January 31, 2025, referred to as TC24, whose initial CDR activity was credited during reporting period February 1, 2024 – March 31, 2025. The validation of this project was completed by 350Solutions in March 2025 and remains valid until January 31, 2029. The validation report can be found on the Isometric Registry [here](#).

350Solutions affirms that Planetary Technologies has quantified GHG removal using appropriate equipment, procedures, and protocols for the addition of mineral alkalinity and subsequent air-sea CO₂ exchange in accordance with the requirements of the applicable Isometric standards, protocols and modules.

The carbon removals for the reporting period are provided in Table 2. These values have been verified by 350Solutions.

Table 2. Verified Total Removals by Planetary for Reporting Period Ending August 26, 2025

Isometric Removal ID	Sequestration Start Date	Sequestration End Date	Net tonnes CO ₂ e removed
rmv_1K3K08NV61S06MDD	Feb 1, 2025	Aug 26, 2025	1189.65

The quantity of 1189.65 tonnes of net carbon removals has been verified with a reasonable level of assurance and are eligible for crediting under the referenced Isometric Standard and Protocol.

Verifier Information		
Verification Body	Verifier	Verification ID No.
350Solutions, Inc.	Zoe Sandwith	350VR-IS2516-VR1

Zoe Sandwith
 Digitally signed by Zoe Sandwith
 Date: 2025.10.01 11:24:05 -07'00'
Signed: Zoe Sandwith (Verifier)



Lily Schacht
 Digitally signed by Lily Schacht
 Date: 2025.10.01 14:22:12 -04'00'
Lily Schacht (QA)

2. Verification Details

2.1. Objectives

A planned series of verification activities (Table 3) was conducted by 350Solutions to reach a conclusion about the accuracy of the GHG statement and compliance with the criteria listed in Section 3.2 of this document.

2.2. Responsibilities

The project proponent, Planetary Technologies, is responsible for the fair presentation of the PDD in accordance with Isometric criteria. It is the responsibility of 350Solutions to express an opinion

as to whether the GHG statement and supporting documents support verification of the claimed carbon removals.

2.3. Level of Assurance & Materiality

The verification was completed with a reasonable level of assurance. The materiality threshold of 5%, considering the totality of all omissions, errors, and misstatements, was applied to this audit.

2.4. Validation and Verification Body details

350Solutions Inc. declares that we are an impartial verifying body, free from any conflicts of interest, capable, and qualified to complete this validation and verification for the current operational period according to the Isometric Standard and applicable protocols and modules.

350Solutions is an accredited inspection & verification body by ANAB under ISO 17020 for completion of ISO 14034 Technology Verifications and was the first accredited entity in North America for ISO 14034. 350Solutions is based out of Raleigh, North Carolina, USA. The Technical Lead for the Nova Scotia Mineral OAE project validation and first verification was Lily Schacht. Zoe Sandwith is the continuing project lead hereafter. Veronica Tamsitt from Submarine Scientific was subcontracted by 350Solutions to assist in model verification using the Air-Sea CO₂ Exchange module. Technical review and approval was provided by Lily Schacht. Complete verifier qualifications are included in Appendix 4.

2.5. Approach

The verification process activities are described in Table 3. Appendix 1 contains the list of findings identified throughout the validation and verification process. The list of files that were reviewed are listed in Appendix 3.

Table 3. Validation and Verification Activities

Date(s)	Activity	Tasks	Documents Reviewed
August 30-September 29, 2025	Review of reporting period modifications to PDD	- Review of GHG statement	- See Appendix 3
August 30-September 29, 2025	Review of current validation and GHG statement applicability	- Review of Validation and initial Verification report - Identification of major and minor process steps, measurements, and calculations - Review of relevant Standard, Protocol, and Modules	- See Appendix 3
August 30-September 29, 2025	Verification of Removals	- Compilation of verification issues and recommendations in log of findings - Review of Planetary's responses and record resolutions in log of findings - Review of measurements and calculations - Review of monitoring data	- See Appendix 3

		- Review of GHG statement - Write verification report	
September 29-30, 2025	Quality assurance and revisions	- Internal review - Review by Isometric - Review by Planetary - Revisions based on internal and external review	- N/A

3. Technical Aspects

3.1. Project Description

Planetary Technologies doses alkaline feedstock into coastal outfalls to increase the local alkalinity of the seawater, called ocean alkalinity enhancement (OAE). This alkalinity neutralizes acidic dissolved carbon dioxide (H_2CO_3) that is present in seawater by converting it into carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) ions that are already abundant in the ocean. As ocean carbon dioxide (CO_2) is consumed by this process, the ocean absorbs CO_2 from the atmosphere to bring the air and ocean back into chemical equilibrium. Assuming steady state, the mean seawater residence time of alkaline dissolved carbon ions (CO_3^{2-} and HCO_3^-) charged-balanced by cations other than H^+ is about 100,000 yrs. The Nova Scotia Mineral OAE Project takes place in Dartmouth, Nova Scotia, Canada on the site of Nova Scotia Power's Tufts Cove Generating Station. Planetary's feedstock for this project is a byproduct of magnesia production, that is primarily made up of magnesium oxide (MgO) and magnesium carbonate (MgCO_3). The feedstock is shipped from Spain and temporarily stored in a nearby warehouse or in an onsite shipping container.

Seawater is pulled from the return line of the power plant's cooling loop into the mixing tank and mixed with the feedstock to form a slurry (Figure 1). The slurry residence time in the mixing tank is 30-60 minutes. The slurry is then dosed into the outfall, where it mixes with the cooling loop water before entering the ocean.

Gross carbon dioxide removal (CDR) is quantified using near- and far-field modeling using the feedstock dosing record as the input. The feedstock dosing record is used as an input to a coastal 150 m horizontal resolution physical (Regional Ocean Modeling System or ROMS) and biogeochemical model (based on Fennel et al., 2006, 2008) of the Halifax Harbor. A 1D alkalinity release model is used to parameterize alkalinity input to the ROMS model with a 2-phase (particulate and dissolved) proxy.

The unequilibrated alkalinity that leaves the regional domain through the open boundaries is used as input to a global $1/3^\circ$ horizontal resolution data assimilative ocean physical and biogeochemical model (ECCO LLC270 physics with the MITgcm gchem and DIC packages). CDR in ECCO is quantified as the difference in cumulative air-sea CO_2 flux between the dosing and baseline simulations. The gross CDR is the sum of the CDR calculated in the ROMS and ECCO models.

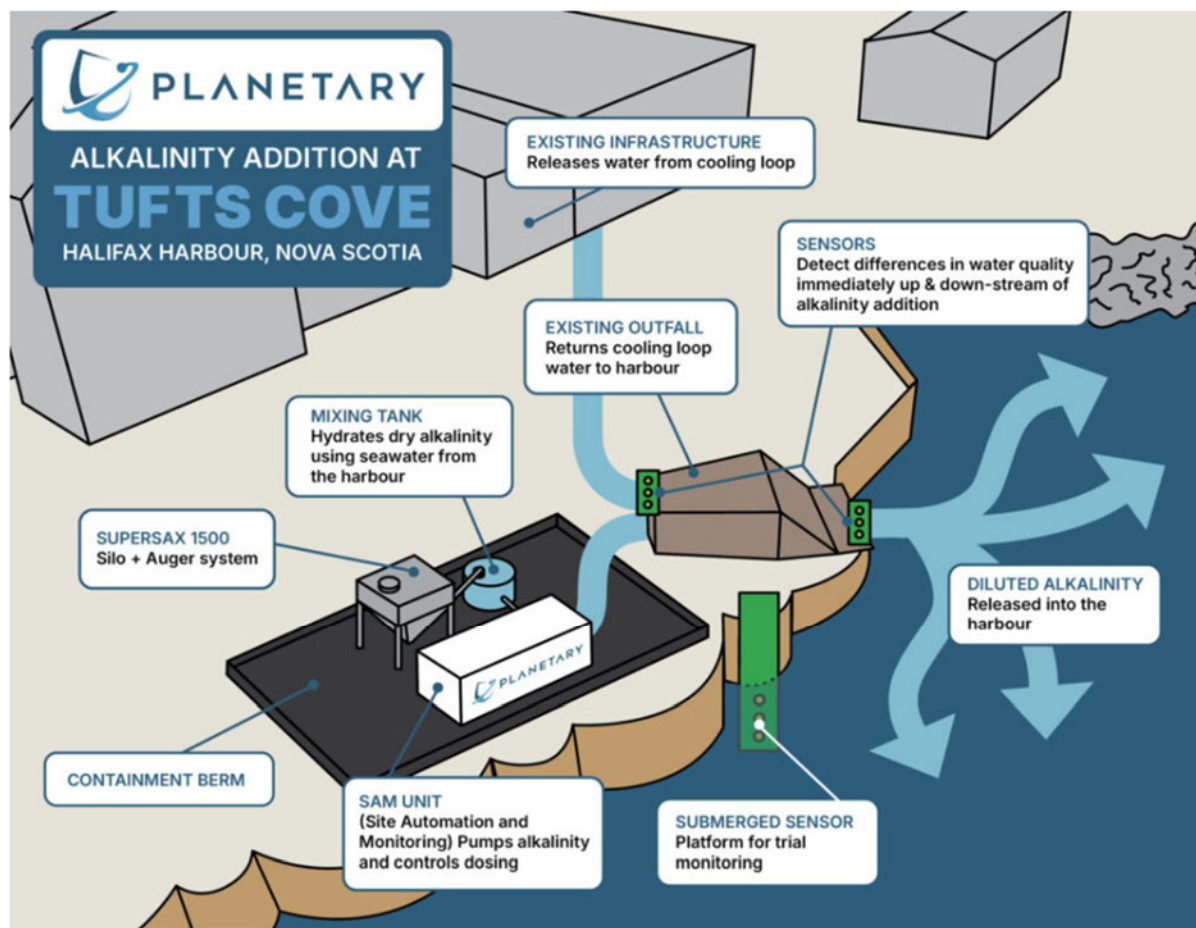


Figure 1. Overview of Planetary Process at Tufts Cove. Beginning on October 15, 2024, feedstock was dispensed directly into the mixing tank, rather than using the Supersax 1500. Credit: Planetary

Planetary has several monitoring locations to ensure the added alkalinity does not create an unsafe perturbation in the outfall plume. There are two multiparameter sondes that continuously measure pH, total suspended solids (TSS), temperature (T), and salinity (S) before and after the alkalinity is added to the cooling loop water. This is supplemented by weekly bottle samples to measure total alkalinity (TA) and confirm TSS, S, and pH measurements and data collected from a monitoring system at a mooring next to the outfall with several continuously monitored parameters. See Table 7 for the complete list of monitored parameters.

3.2. Protocols and Modules Applied

The validation and verification were conducted following the specifications of the following standards, protocols, and modules:

- Isometric Standard V1.7 [1]
- Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 [2]
- Dissolved Inorganic Carbon Storage in Oceans V1.0 [3]
- Air-Sea CO₂ Uptake V1.0 [4]
- Rock and Mineral Feedstock Characterization V1.1 [5]

- Energy Use Accounting V1.2 [6]
- Transportation Emissions Accounting V1.1 [7]
- Embodied Emissions Accounting V1.0 [8]

3.3. Project Boundary

The greenhouse gas sources, sinks, and reservoirs within the system boundary for Nova Scotia Mineral OAE are listed in Table 4.

Table 4. GHG Sources, Sinks, and Reservoirs

Activity	SSR	Quantification Method
Project Establishment	Initial surveys and feasibility studies	No initial surveys or feasibility studies attributed to this project
	Equipment & materials manufacture and transport	Material-based emissions factors (e.g., 10 kg of polyethylene) from expense reports for equipment and initial consumables purchased
	Construction and installation	No permanent construction occurred for the project, existing infrastructure is used
Operations	Energy use	Fuel for telehandler measured directly. Electricity either measured directly or calculated based on equipment specs before the power meter was operational (Jan 2025)
	Feedstock manufacturing and transport	Feedstock meets the definition of a waste material by Section 7.2.1 of the OAE protocol. Electricity for feedstock packaging is included, along with the emissions associated with the packaging material. Transportation emissions are calculated using GLEC distance-based emissions factors
	Consumables	Material-based emissions factors (e.g., 10 kg of polyethylene) from expense reports
	Waste processing	Pallets are recycled and bulk bags are landfilled. Transportation emissions are accounted for.
	MRV	Fuel for sampling boat is measured directly. Electricity for sensing equipment is included in operational electricity.
	Staff travel	Calculated based on individual reporting or expense reports
	Surveys	Included in MRV
	CO ₂ stored	Near-field (ROMS) and far-field (ECCO) modeling. See Section 3.1.
	Maintenance of project site	All purchased materials included in consumables. Electricity for site metered.
End-of-Life	End-of-life emissions	Included in project establishment
	Ongoing sampling and monitoring for MRV	N/A – project is ongoing so sampling and monitoring will be accounted for in subsequent reporting periods

3.4. Changes since Validation and Previous Verification(s)

3.4.1. Quantification changes

This verification marks the first instance of incorporating continued equilibration of past alkalinity dosing to the carbon removal generated by the current dosing period. Subsequent verifications will incorporate continued uptake from multiple dosing periods.

3.4.2. Mooring Sensors

This project was initially validated on March 21, 2025 and remains valid through January 31, 2029. This is the second verification. During validation, Planetary demonstrated use of experimental mooring-tethered pCO₂ and total alkalinity (TA) sensors. These sensors are in development by third parties and were not operational for periods during the first verification reporting period. The pCO₂ sensor remained largely operational during this reporting period, however the TA sensor has been removed for the foreseeable future; therefore, the TA mooring data was not submitted for this verification. This is an acceptable deviation because the mooring measurements located within the mixing zone are not required by the OAE protocol. The required monitoring at the edge of the mixing zone is satisfied by boat surveys.

3.4.3. Interpretation of Permit Monitoring Requirements

The monitoring required by the permit governing Planetary's Tufts Cove Operations stipulates monitoring of TSS at the outfall and requires reporting of any events where TSS exceeds 40mg/L. Planetary had originally interpreted this as a change in TSS post-alkalinity addition (i.e., downstream TSS – upstream TSS = Δ TSS), but it has been clarified by the regulator, Nova Scotia Department of Environment and Climate Change (NS-ECC), that the downstream outfall is not to exceed 40mg/L regardless of the baseline measured at the upstream location. This threshold has been updated in internal protocols, and upon review of TC25.1 data, no exceedances were observed during dosing which would have triggered a report under the new interpretation.

According to the permit from NS-ECC, Planetary is required to submit monitoring data (TA, TSS, pH, and dissolved inorganic carbon) after each "Addition Phase." The "Addition Phase" terminology is carried over from Planetary's pilot phase and no longer has a clear meaning now that they are dosing alkalinity continuously. As a result, it is not evident what the reporting frequency to NS-ECC must be. Planetary has not submitted the required monitoring data for this dosing period (February 1 – June 30, 2025) to NS-ECC as of September 30, 2025. This is not considered a nonconformance for this verification because the permit does not clearly state the reporting frequency.

Planetary is in the process of renewing their permit with NS-ECC and will address clarifications regarding language used for monitoring and reporting requirements. Topics to address include the change from using discrete 'Addition Phases' to define continuous monitoring and reporting periods, and thus reporting frequency, definitions of expectations around 'immediate reporting' of exceedances, whether continuous monitoring of the outfall is required regardless of dosing status, and discussion of change of monitoring approach to reduce emphasis on the mooring platform and instead use the water sampling stations supplied by boat surveys based on operational experience to date. Planetary will submit the updated permit for the dosing period when it goes into effect (December 2025).

3.4.4. Stop-Trigger Framework Exceedances and Changes

Stop-trigger actions were triggered during this reporting period on May 15th for duplicate water samples taken 1m above the sediment at the 'Narrows' station. Dosing was stopped at 16:00UTC and the regulator was notified of the copper and mercury exceedances at the Narrows bottom water station on May 20th. Subsequent sample analyses were back below thresholds and causal link was not established to Planetary activities, and attribution is considered to be more likely due to sample heterogeneity, storm and/or wastewater discharge, legacy metals in Halifax Harbour, or sediment resuspension during bottom-water collection. The reporting timeline was longer than the 48hrs stipulated in the original PDD stop-trigger framework. Due to the regulator's acknowledgement of the reporting, lack of feedback involving timing, and the voluntary nature of the ocean and sediment metals monitoring this is deemed acceptable in this case.

This exceedance report and subsequent considerations and consultations with the environmental consulting firm Dillon, who performed the Environmental Impact Analysis for project establishment, lead to a change in the structure of the stop-trigger framework and subsequent update of the PDD. This change allows dosing to continue until causal link for metals increase in water or sediments to Planetary activities is established. Considering turnaround time of lab analyses on the order of weeks, this opens the risk of several weeks of dosing occurring before potential causal link is established, even when lab operations for follow-up sampling can be expedited. Planetary is exploring options for further refining this stop-trigger through methods such as comparing metals ratios, as well as alternative labs with faster turn-around times.

3.4.5. Calculation method for determining EQOH

For TC25.1, a new equation for calculating EQOH was used which includes terms for potassium and sodium carbonates. For TC25.1 the new and previous calculation methods differed by an average of 0.055%. Additionally, the sampling and weighing protocol were updated such that feedstock bags are sampled and composited by week instead of by lot. These are acceptable deviations as each bag is still sampled and accounted for in a weighted average and difference in calculation technique is below the materiality threshold.

3.4.6. Monitoring Station Changes

'Narrows' Sampling station was added ~500m SE of outfall, and Sackville River monitoring was reduced as the station is deemed uninformative to the impact of dosing activities. These stations are in addition to the required monitoring activities of the protocol, therefore this is acceptable.

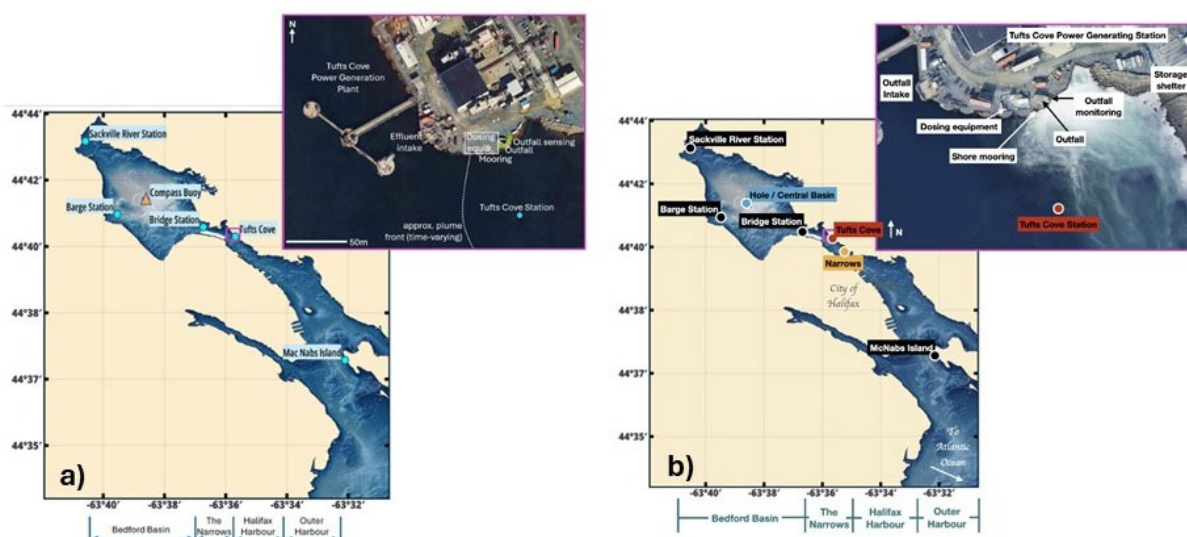


Figure 2. a) Original PDD monitoring stations and b) changes to monitoring stations introduced in TC25.1. Credit: Planetary

3.4.7. Minor PDD updates

References added to highlight the use of both ECCO and ROMS models and minor formatting changes in section 1.5 do not cause any substantive changes

3.4.8. Minor LCA change

Packaging and Waste line item is no longer included under “Project Establishment” as it is accounted for in “Waste Disposal”. The removal of double counting of this term is an acceptable change. Slight updates were made to emissions factors which resulted in higher uncertainty in all LCA components. In order to estimate uncertainty conservatively, this updated uncertainty model was applied to the TC24 emissions.

3.4.9. Minor Modeling Approach Changes

There were several minor changes to the model forcings in ROMS and ECCO which impact the CDR and uncertainty quantification. The ROMS nearfield model was forced with up-to-date surface (atmospheric) and lateral (oceanic) boundary condition datasets that coincided with the actual project reporting period. Previously the ROMS nearfield model was run with historic forcing data, and an ensemble of experiments with different initial forcing years were run to capture the uncertainty due to interannual variability. Given the use of forcing data that coincided with the actual project reporting period, this uncertainty due to interannual variability in the ROMS nearfield model is eliminated and no longer quantified. This update is justified and anticipated, and with the elimination of this source of uncertainty, the next largest sources of uncertainty (systemic uncertainty in the ROMS nearfield model resolution and representation of sediment interactions) are estimated and added to the CDR uncertainty. No substantive structural changes to the underlying ROMS nearfield model configuration were made and model forcing updates are expected as up-to-date forcing data become available, so prior validation of the ROMS nearfield model remains valid.

The global ECCO model was updated to apply a more temporally consistent treatment of alkalinity upscaling from the near-field ROMS model to the far-field ECCO model by phasing the exported alkalinity into ECCO, rather than it being represented by a single addition at the end of the ROMS simulation. The unequilibrated fraction of added alkalinity exported from the ROMS nearfield model domain is integrated along the open boundaries to generate a monthly resolution forcing of upscaled alkalinity for input to ECCO. A minimum 5-member ensemble of ECCO simulations are performed, covering the same months as the ROMS simulation (defined by the start and end of dosing activity), but with different start years to assess the impact of interannual variability. Each ECCO ensemble member is run for 2-years, with the remaining unequilibrated fraction of added alkalinity at the end of the ROMS nearfield simulation added over the first 30-days following the end of the dosing period. No structural changes to the underlying ECCO global model were made and model alkalinity forcing updates are expected with new data, so prior validation of the ECCO global model remains valid.

4. Crediting Details

4.1. Reporting Period

This is the 2nd reporting period for this project, spanning April 1, 2025 to August 26, 2025.

4.2. Crediting Period

This project was initially validated on March 21, 2025, with a crediting period of February 1, 2024 to January 31, 2029. This is the first crediting period for this project.

5. Validation and Verification Summary

5.1. Accuracy of the Statement

The values represented in the GHG statement have been evaluated, cross-referenced with the presented evidence, and confirmed. Confirmation of the GHG statement has been based on the following efforts:

1. Recalculation of removals, including:
 - a. Recalculation of Gross CDR from ROMS model output with up-to-date atmospheric forcing and boundary conditions that align with the reporting period at end of January 2025 derived from the difference in the cumulative air-sea CO₂ flux in the baseline and dosing simulations
 - b. Recalculation of Gross CDR from example ECCO model output (for a single ensemble member) at end of August 2025 derived from difference in the cumulative air-sea CO₂ flux in the baseline and dosing simulations, and from the difference in DIC inventory between the baseline and dosing simulations at the end of the ECCO model experiment
2. Recalculation of error propagation (uncertainty) of net CDR calculation
3. Review of monitoring data to check for large disturbances or regulatory exceedances

4. Review of supporting data for operations emissions during the reporting period
5. Review of analytical data quality, methods, and uncertainty analysis
6. Review of feedstock characterization
7. Review of environmental safeguarding practices

Issues identified during the verification process are listed in Appendix 1.

Each term in the net CDR calculation was recalculated where possible, or the approach or justification reviewed, where direct recalculation was not possible. The terms and corresponding values for this reporting period are listed in Table 5. The individual parameters for each dosing period (TC24 and TC25.1) are listed in Appendix 2. For additional detail, see the Calculation view for this reporting period on the Isometric Registry.

Table 5. Net CDR Calculation for the Reporting Period from April 1, 2025 to August 26, 2025

Parameter	Value (tonnes CO ₂ e) ¹	Source
Net CDR	1189.65	OAE Protocol Equation 1
CO₂e (Air Sea Flux)	1390.61	Air-Sea CO ₂ Uptake Module Equation 3
TC24	212.87	
Cumulative	1094.63	
Previously Credited	-881.77	
TC25.1	1177.69	
CO₂e (Emissions)	137.66	OAE Protocol Equation 6
CO₂e (Establishment)	3.84	Modeled based on material use
CO₂e (Feedstock Sourcing)	99.61	Alkalinity production and transport
CO₂e (Operations)	34.21	Personnel transport and accommodations, operations and monitoring
Uncertainty	63.30	Propagated uncertainty from gross CDR and LCA
Cumulative	168.10	
Previously Deducted²	-104.80	

¹ Values have been rounded and may not add up without error.

² As described in Section 3.4.9, use of surface (atmospheric) and lateral (oceanic) boundary condition datasets that coincided with the actual project reporting period decreased the uncertainty in model output. Rather than integrating over the current sequestration period, model results are reported as cumulative since the alkalinity was dosed, then previously credited CDR is deducted.

5.2. Validation and Verification Opinion

350Solutions has reviewed the documentation of the technology, the instrumentation, the procedures, and performance and has found that the data presented in the GHG Statement and its supporting documents:

☒ **Meets the requirements of the Isometric Standard V1.7.6 and Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 for Verification**

☐ **Meets the requirements of the Isometric Standard V1.7.6 and Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 with minor modifications for Verification**

❑ Does not meet the requirements of the Isometric Standard V1.7.6 and Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 for Verification

Our opinion is provided with a reasonable level of assurance of Planetary's operations at Tufts Cove Power Generating Station and associated activities (alkalinity sourcing, ocean monitoring)

Notice: 350Solutions, Inc. declares that we are an impartial auditor, free from any conflicts of interest, capable, and qualified to complete this audit according to the Isometric Standard and related Validation and Verification Body Requirements. Verifications and audits conducted by 350Solutions are based on an evaluation of technology performance and CO₂ removal claims via site visit observations and review of data submitted by the audited company. Audits are completed in accordance with rules and methodologies specified by Isometric and utilizing the appropriate quality assurance procedures established under the 350Solutions accredited ISO 17020/14034 Quality Management Program, noting that this verification is not a fully compliant ISO 14034 verification. 350Solutions makes no expressed or implied warranties as to the performance of the technology and does not certify that a technology will always operate at the levels verified, nor that it meets all state, local, or federal legal requirements.

5.3. Summary of Validation and Verification Findings

Table 6 contains a summary of findings for each section of the Isometric Standard and any additional requirements imposed by the relevant protocol and module(s).

Table 6. Eligibility criteria for Isometric's Standard, protocol, and modules relevant to Nova Scotia Mineral OAE

Reference	Criteria	Findings
Isometric Standard		
2.5.1	<i>Boundaries</i>	Acceptable. No change since validation.
2.5.2	<i>Baselines</i>	Acceptable. No change since validation.
2.5.3	<i>Additionality</i>	Acceptable. No change since validation.
2.5.4	<i>Market Leakage</i>	Acceptable. Planetary's feedstock consumption for this reporting period represents [2%] of the supplier's 2023 total production (the most recent year with complete data). The feedstock producer typically sells ~5% of the product produced, as it has little commercial value. The remaining material is stockpiled indefinitely.
2.5.5	<i>Life cycle assessment</i>	Acceptable. Approach and emissions factors previously validated. Some minor revisions to emissions factors.
2.5.7	<i>Uncertainty</i>	Acceptable. Gross CDR uncertainty estimated using model ensembles to capture interannual variability and parametric uncertainties and an additional 5% uncertainty added to the gross CDR determined from the ROMS nearfield model to account for systemic uncertainties in the model's resolution and representation of sediment interactions, uncertainty on emissions estimated using a Monte Carlo approach in SimaPro.
2.5.8	<i>Monitoring</i>	Acceptable. Monitoring took place as planned other than optional parameters collected on the tethered mooring (TA), and some modifications to the ocean sampling station locations.
3.7	<i>Environmental and socio-economic safeguarding</i>	Acceptable. Environmental safeguarding through monitoring, as described above, and previously conducted ecological impact studies. Stakeholder engagement was not reviewed for this reporting period.
Ocean Alkalinity Enhancement from Coastal Outfalls		

4	<i>Applicability</i>	Acceptable. No change since validation.
8.2	<i>Gross CDR Calculation</i>	Acceptable. Gross CDR calculation based on modeling of air-sea CO ₂ uptake.
9.2	<i>Buffer Pools</i>	Acceptable. Very low risk of reversal.
10	<i>Pre-deployment Requirements</i>	Acceptable. Requirements confirmed during validation.
Air-Sea CO₂ Uptake		
3.1	<i>Model configuration requirements</i>	Acceptable. No change since validation.
3.1.4	<i>Model output provided</i>	Acceptable. Adequate model output provided to recalculate Gross CDR for ROMS and ECCO models from cumulative air-sea CO ₂ flux difference and/or change in DIC inventory between baseline and dosing simulations.
4.0	<i>Quantification of model uncertainty</i>	Acceptable. Updates since previous validation include no longer including uncertainty due to interannual variability in the ROMS nearfield model as it is now forced with up-to-date real time atmospheric and boundary conditions that align with the reporting period. An additional $\pm 5\%$ uncertainty has also been added to the ROMS nearfield model Gross CDR to account for systemic uncertainties in model resolution and sediment interactions identified in Laurent et al. 2025.
4.1	<i>Meet requirements for model validation</i>	Acceptable. Manuscript with validation of biogeochemistry in ROMS nearfield model now published publicly in an academic journal (Laurent et al. 2025).
5.0	<i>Required records and documentation.</i>	Acceptable. Provided minimum ROMS code and description of configuration, and complete configuration and ECCO code needed to repeat the simulation and results from model sensitivity tests and assessment of uncertainty.
Rock and Mineral Feedstock Characterization		
3.1	<i>Analytical Methods</i>	Acceptable. No change since validation.
3.2	<i>Sample Preparation and Handling</i>	Acceptable. No change since validation.
3.3	<i>Physical Characterization</i>	Acceptable. No change since validation.
3.4	<i>Geochemical Characterization</i>	Acceptable. No change since validation.
OVERALL ELIGIBILITY		ELIGIBLE
Reporting Period		April 1, 2025 – August 26, 2025

5.4. Monitoring Requirements

Table 7. Monitoring Requirements

Input / Output Stream	Sub-Process	Required Data (Measurement or estimate)	Units	Exceedance or significant perturbation during reporting period?
Ocean outfall		Upstream seawater pH	pH units	[Note 1]

	Up- and downstream outfall sensing	Upstream seawater TSS	mg/L	[Note 1]
		Upstream seawater temperature	°C	[Note 1]
		Upstream seawater salinity	PSU	[Note 1]
		Downstream seawater pH	pH units	No
		Downstream seawater TSS	mg/L	No
		Downstream seawater temperature	°C	No
		Downstream seawater salinity	PSU	No
		Bottle Samples – TA	µmol/kg	No
	Dosing	Alkalinity dosing rate	kg/min	No
		Flow rate	L/min	No
Bulk Ocean	Ocean monitoring - Moored Sensors	Ocean and air pCO ₂	ppm	[Note 2]
		Ocean pH	pH units	No
		Ocean temperature	°C	No
		Ocean TSS	mg/L	No
		Ocean salinity	ppt	No
		Ocean total alkalinity	µmol/kg	[Note 2]
		Ocean chlorophyll <i>a</i>	mg/L	No
Bulk Ocean	Ocean monitoring - Boat sampling	Vertical profiles - Ocean pH, TSS, dissolved oxygen, temperature, salinity	pH units, mg/L, % saturation, °C, PSU, µmol/m ² /s	No
		Bottle samples - Ocean alkalinity, pH, TSS, salinity, trace metals	µmol/kg, pH units, mg/L, PSU, mg/L	No
		Sediment grabs - Sediment metals content	mg/kg	No

Notes:

- 1 – Upstream measurements are used to calculate the change caused by Planetary’s operations. Upstream measurements are not required by the protocol or permit. Only the downstream measurements are required.
- 2 – pCO₂ and TA sensors on the mooring are experimental sensors. For this verification the pCO₂ sensor remained operational for the majority of the reporting period, however the TA sensor was removed from the mooring system entirely. None of the mooring data is required by the protocol, and the boat surveys satisfy the regulatory monitoring intent, therefore this is an acceptable deviation.

5.5. Verification Limitations

Forward Action Requests (FARs) identified during this verification (Appendix 1) have been investigated and deemed acceptable for this verification. These will be addressed in upcoming verifications.

6. Revision History

Version	Date Issued	Noted Changes
Version 1.0 (v1.0)	September 29, 2025	Initial Version
Version 1.1 (v1.1)	September 30, 2025	Edits based on internal QA review
Version 1.2 (v1.2)	September 30, 2025	Edits based on external review

7. References

- [1] Isometric, “Isometric Standard v1.6.2.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/standard/1.7.6>
- [2] Isometric, “Ocean Alkalinity Enhancement from Coastal Outfalls v1.0.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/protocol/ocean-alkalinity-enhancement/1.0>
- [3] Isometric, “Dissolved Inorganic Carbon Storage in Oceans v1.0.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/module/dic-storage-in-oceans/1.0>
- [4] Isometric, “Air-Sea CO₂ Uptake - V1.0.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/protocol/air-sea-gas-exchange/1.0>
- [5] Isometric, “Rock and Mineral Feedstock Characterization V1.1.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/module/rock-and-mineral-feedstock-characterization/1.1>
- [6] Isometric, “Energy Use Accounting v1.2.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/module/energy-use-accounting/1.2>
- [7] Isometric, “Transportation Emissions Accounting v1.1.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/module/transportation/1.1>
- [8] Isometric, “Embodied Emissions Accounting v1.0.3.” Accessed: Sept. 18, 2025. [Online]. Available: <https://registry.isometric.com/module/embodied-emissions/1.0>

Appendix 1: Log of Findings

All material clarifications, misstatements, and omissions have been resolved.

ID No	Type	Date Issued	Category	Finding/Issue	Audit Evidence	Protocol Reference	Planetary Response	Conclusion/Resolution	Date Resolved
1	Forward Action Request	12-Sep	Monitoring	Updated stop-trigger framework where dosing continues until causal link has been established due to project activity has the potential to introduce weeks of lag-time between initial anomolous metals concentrations in monitoring sampling, and confirmation of causal link given current turn-around times.	Planetary PDD update TC25.1.pdf and email correspondance with W Burt 2025-09-12	6.5	Planetary is looking into use of metals ratios and specific potential metals tracers that might give a better 'tracer' or indicator of a feedstock link from the initial analyses, such that a more appropriate 'dosing/stop-dosing' decision tree can be designed. Work on this is actively in development. Planetary is also looking for ways to reduce turn-around times between sampling events.	Share plan for metals source attribution analysis once complete	13-Sep
2	Forward Action Request	15-Sep	Quantification	Mean feedstock bag weight used in lieu of bag weight for 33 of the bags dosed in TC25.1. How was this value determined?	src_1K3RQZRHX1S0YKFK_Detailed_Dosing_Log.xlsx	7.4.1.1	All bags received to date that did not have obvious large tears or missing material were used in calculation of mean	Going forward, Mean bag weight - SE calculated from bags from the dosing period in question may be considered an acceptable substitute for a missing value. Should the % of missing weights increase substantially from the current Dosing, this will be revisited. Planetary is considering workflow options for reweighing bags	17-Sep

3	Forward Action Request	18-Sep	Safeguarding/Stop triggers	TSS difference between upstream and downstream in outfall exceeded 40 mg/L several times on April 7th and 8th, and several times in march. It does not appear that dosing was stopped as stated by the stop-trigger framework. This is not addressed in the Quantification or operations reports, but is visually highlighted in the monitoring data powerpoint summary. The stop-trigger framework also specifies reporting to regulatory body within 48 hours. Was this done?	TC25.1 monitoring data for 350.pptx; outfall_2025-03.csv; outfall_2025-04; Copy of DG_Amendment_approval_17ma24.pdf	10.0	The regulator was not notified as the exceedances were during times where planetary was not dosing and instruments were not operating as they should. The regulator is only interested in QC'd data. and these exceedances were removed during QA/QC.	Discussions are in progress with the regulator regarding the permit renewal and clarifications will be requested. The previous permit expired on Sept 5, 2025, and a temporary extension of the same terms was granted until December 6th.	24-Sep
4	Forward Action Request	18-Sep	Permitting	Clarifications and language needed in next permit issuance: TSS monitoring requirements, timeframes defined by the use of 'immediate reporting', updating of use of addition phase language to reflect current practice, update to reflect current mooring and boat survey monitoring practices, and clarify requirement of monitoring and submitting data	Copy of DG_Amendment_approval_17Ma24.pdf	10.0	Planetary is actively in the process of renewing its Dangerous Goods permit. The current permit has been extended from Sept 6 - Dec 6 to allow time for updates and modifications to be made. These issues will be addressed with the regulatory body.	Acceptable with FAR. Until the language is updated, NS-ECC should have requested data reported to them at the end of each reporting period.	24-Sep
5	Omission	11-Sep	Monitoring	Please submit raw data and calibration information for all sensors and chemical measurements, as well as qualified operator CV in support of suitability for qualitative QC assessment decisions. These are required for full assessment of all data QA/QC	Multiple data files supplied were cleaned, QA/QCd data	10.0	Submitted as requested by 350Solutions throughout verification process	Supplied	26-Sep
6	Omission	18-Sep	Permitting	Please submit evidence that Nova Scotia Power agreed to extend the First Amending Agreement beyond May 1, 2025	Planetary - First Amending Agreement_signed_22May24.docx (1).pdf	6.2	Planetary - NSP Second Amending Agreement - signed.pdf	Supplied	24-Sep

7	Omission	24-Sep	Modeling	Please submit raw data for the air-sea CO ₂ flux for the ECCO model (for the same timestep and ensemble run as the DIC data have been provided). Please also submit all MITgcm grid and metadata files (.data and .meta and .log) required to read the raw ECCO output files.	Model Output For Verification Google Drive folder, includes many model raw output files and DIC inventory .csv files	Air-Sea CO ₂ Uptake Module 3.5	Submitted as requested by 350Solutions throughout verification process	Supplied	25-Sep
8	Clarification	24-Sep	Modeling	Referring to the parametric uncertainty quantification runs in Table 6.1: "The 10 runs listed have a standard deviation of 7.4%, but the mixed-layer depth and diffusivity sensitivities will to some extent already be covered by the uncertainty resulting from interannual variability. Only the runs reflecting $\pm 15\%$ uncertainty in the air-sea flux parameterization ¹⁰ are independent of these interannual effects, and these runs resulted in an uncertainty of $\pm 6.51\%$." It appears the outcome of this is that the 6.51% parametric uncertainty was used in the final uncertainty quantification, from only the air-sea gas exchange and not the other parameters, meaning the remaining uncertainty was all assumed to be fully accounted for by interannual variability uncertainty. Is my interpretation of this correct? If so, I don't think this is convincingly justified. The interannual variability ensemble quantifies uncertainty from external forcing variability (for ECCO only as ROMS now uses real-time forcing), not internal model parameter uncertainty.	CDR quantification - TC25.1.pdf and email correspondence with Max Holloway, 25-Sep	Air-Sea CO ₂ Uptake Module	I confirm that the $\pm 6.51\%$ uncertainty derived from the $\pm 15\%$ air-sea gas-exchange sensitivity runs was retained as the parametric contribution in the final uncertainty budget. The ECCO ensemble is a physical data-assimilative ocean state estimate designed to sample the maximum spread in CDR responses, reflecting variability in mixed-layer depth and vertical mixing, thus already sampling these sources of uncertainty. For ROMS, added alkalinity remains almost entirely in the top 40 m and the model's validation presented in Wang et al. (2025), specifically simulating the physical dynamics of Halifax Harbour including the vertical structure of the water column, demonstrate the model's capability to capture MLD and vertical mixing accurately in the region, supporting the value of 6.51% for parametric uncertainty in the crediting calculation. If more justification is needed (and given time constraints), I can increase the parametric uncertainty to 7.4 % to reflect the full range of sensitivities and	Parametric uncertainty updated to 7.4% as conservative measure given incomplete justification for excluding uncertainty due to model representation of mixed layer depth and vertical diffusivities.	25-Sep

				Mixed-layer depth and vertical diffusivity affect CDR through mechanisms that are not spanned by year-to-year forcing differences, and they may be systematically biased. Mixed layer depth and Kz (ks, kd) affect entrainment, residence time, vertical isolation, and the dilution of added alkalinity or carbon. Errors can occur on synoptic to seasonal timescales, not just interannual, and can also be biased in sign or magnitude across the whole simulation.			update the quantification document before re-sharing.		
9	Clarification	24-Sep	Modeling	Removing interannual variability uncertainty for ROMS is justified by using forcing datasets that represent the actual time period (which are based on measurements). So I think that change is as expected. I have some concerns with how this has been written/communicated in the CDR quantification doc because I think it's confusing how it has been worded. 'Climatology'/'Climatological' is used quite often. Typically this term is understood to mean a statistical average over many years of a given parameter/dataset to actually average out year to year variability to reveal a 'typical' climate state. In the quantification doc 'climatology' and 'climatological' have been used repeatedly when referring to forcing datasets for the actual 'real-time' period of dosing to the reporting date (2024 - 2025), which are not 'climatologies' at all as typically	CDR quantification - TC25.1.pdf and email correspondence with Max Holloway, 25-Sep	Air-Sea CO2 Uptake Module	I agree with your use of the term 'climatology'. I had introduced the update as "up-to-date surface and lateral boundary forcing" and "real-time boundary forcing, incorporating meteorological and oceanic conditions at both the surface and lateral boundaries concurrent with the dosing period". I see that the term climatological is used elsewhere interchangeably and have amended these in the quantification document to be consistent.	CDR quantification TC25.1.pdf updated terminology for clarity	25-Sep

				defined, as they represent a specific year/time period as opposed to a long term average. I think this language needs to be changed to clarify, maybe clearly defining a term to refer to the forcing data that match the actual dosing and reporting time period would be useful, e.g. forcing with 'real-time' data as opposed to forcing with 'historic' data. I think this is very important to communicate clearly as I think most people who haven't thought about this very deeply would assume the forcing always is run with 'real-time' data rather than 'historic' forcing. Here's an example definition of climatology: "According to the World Meteorological Organization, the term 'climatology' defines long-term averages of a given variable, like sea surface temperature, over various time periods, usually 30 years. In oceanography, the term 'ocean climate' is used to define ocean parameters averaged over a decade or longer."					
10	Clarification	24-Sep	Modeling	Is there any justification for the choice of +/- 5% uncertainty applied to the CDR_ROMS (to recognize the resolution effects and sediment interaction uncertainty)? Does Laurent et al provide context for this number?	CDR quantification - TC25.1.pdf and email correspondance with Max Holloway, 25-Sep	Air-Sea CO2 Uptake Module	No quantification of these uncertainties in Laurent et al. 2025. A 5% uncertainty margin was chosen as a conservative and pragmatic estimate to account for these unknown uncertainties.	Acceptable, no updates necessary	25-Sep
11	Clarification	9/24/2025	Modeling	Do the ECCO ensemble years match the same years run with ECCO to get interannual variability uncertainty as the last crediting period? If not, what's the justification for the years chosen? It's not super clear here whether it	CDR quantification - TC25.1.pdf and email correspondance with Max Holloway, 25-Sep	Air-Sea CO2 Uptake Module	The ECCO ensembles were expanded to include the same plus additional years (n=8) for both TC24 and TC25.1 dosing profiles. The years were chosen to span the range, including the minimum and maximum, of CDR	Acceptable, no updates necessary	25-Sep

				differs from the last crediting and if so what is meant by "full range of results" for choosing the years for the ensemble.			responses that we have sampled so far from the ECCO simulation period. With time we will expand our library of simulations to include more years/months from the ensemble to better understand the full range of responses.		
12	Clarification	9/24/2025	Modeling	Table 6.3 says '(see note)' in the ROMS+ECCO combined inter-annual variability row, but what note? This doesn't refer to anything specifically, can you point to where the note is?	CDR quantification - TC25.1.pdf and email correspondence with Max Holloway, 25-Sep	Air-Sea CO2 Uptake Module	The 'note' was legacy text from the TC24 submission, explaining how the ROMS and ECCO uncertainties were combined. I have removed it from the TC25.1 document	CDR quantification TC25.1.pdf updated for clarity	9/25/2025
13	Clarification	9/24/2025	Modeling	I am still getting a different number for ROMS TC24F (514) but the same number as you for TC25_1. Is there any temporal interpolation done/is your ROMS CDR value coming from the last timestep in the model output ('2025-01-31T12:00:00.000000000')? It is odd that I get the TC25_1 result exactly but get something different for TC24F, I am running the exact same code. My cumulative CDR curve looks right and I've attached my script. Are you able to share your analysis script or output with CDR values at each time step so we can try to resolve this mismatch?	CDR quantification - TC25.1.pdf and email correspondence with Max Holloway, 25-Sep	Air-Sea CO2 Uptake Module	the TC24 CDR_ROMS difference is due to a temporal interpolation. Thank you for sharing your script, that made it much easier to diagnose. I have interpolated the ROMS CDR to 2025-01-31 00:00 to match the tracer fields (and the exported alkalinity). And your value is taken at the final timestep, 2025-01-31 12:00. This is not a problem for TC25.1 because both arrays were output on the tracer time of 00:00.	a sentence to the quantification document stating that the near-field CDR cutoff was taken at 2025-01-31 00:00	9/25/2025
14	Clarification	9/24/2025	Modeling	the left column of Table 6.2 and 6.3 don't match (see screenshot), can you please update table 6.2 so it matches 6.3 for clarity?	CDR quantification - TC25.1.pdf and email correspondence with Max Holloway, 25-Sep	Air-Sea CO2 Uptake Module	We will update the table for consistency	Table 6.2 updated for consistency	9/25/2025
15	Clarification	9/24/2025	Modeling	Just working through the ECCO calculation and I'm getting a bit confused about what I'm comparing to what so just wanted	CDR quantification - TC25.1.pdf and email correspondence	Air-Sea CO2 Uptake Module	Yes, your understanding is correct. The example simulation raw output is for the final timestep, and the ex-post CDR is	VT was able to reproduce calculation of CDR at final timestep of example ensemble simulation from	9/25/2025

				to double check with you. From the file naming, I think the PTRACER and surfaceDiag outputs provided are from the 200101 ensemble member (for TC24) and 200103 ensemble member (for TC25_1). And then the final difference in baseline and dosing from the output provided (from DIC inventory or air-sea CO2 flux) gives the final CDR at the end of the 2 year model simulation, NOT at the current reporting date? So I should be able to compare my calculated final CDR number to the final number in the .csv file (ecco_daily_co2_fluxes_TC24F_Halifax_20010731_20040201.csv for TC24 for example)?	with Max Holloway, 25-Sep		calculated as the ensemble mean at the reporting date. Note that the .csv files have been daily interpolated to extract the reporting date.	raw data for TC24 and TC25.1	
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Appendix 2: CDR by Dosing Period

Parameter	Value (tonnes CO ₂ e) ¹				Source	
	TC24	TC25	Project Total	Previously Credited	Reporting Period Total	
CO₂e_{Removal}, RP					1189.65	OAE Protocol Equation 1
CO₂e_{Stored}, RP	1094.68	1177.69	2212.37	881.76	1390.61	Air-Sea CO ₂ Uptake Module Equation 3. TC24 + TC25.1 – previously credited
Total Dosed Alkalinity	545.39 tonnes OH ⁻	633.10 tonnes OH ⁻	N/A	N/A	1178.49 tonnes OH ⁻	(Mass of feedstock dosed) * (mass fraction of alkalinity in feedstock)
Mass of feedstock added	1103.22 tonnes feedstock	1223.99 tonnes feedstock			2327.21 tonnes feedstock	Weighed supersacks
Mass fraction of alkalinity in feedstock (measured)	494.36 kg OH ⁻ /tonne feedstock	517.24 kg OH ⁻ /tonne feedstock			506.4 kg OH ⁻ /tonne feedstock	Calculated from final weighted-average of total chemical composition data
Efficiency of CO₂ uptake	0.0020 tCO ₂ e/kg OH ⁻	0.0019 tCO ₂ e/kg OH ⁻			N/A	Modeled CDR divided by (preliminary mass fraction of alkalinity in feedstock)*(feedstock dosed)
Modeled CDR	1094.68	1177.69			N/A – do not add up because of mass fraction of alkalinity correction	ROMS + ECCO
Near-field CDR	507.04	770.85			N/A	ROMS
Far-field CDR	573.98	406.84			N/A	ECCO
Mass fraction of alkalinity in feedstock (estimated)	488.19 kg OH ⁻ /tonne feedstock	517.24 kg OH ⁻ /tonne feedstock			N/A	Calculated from initial total chemical composition data
CO₂e_{Emissions}, RP	151.33	137.66	288.99	151.33	137.66	OAE Protocol Equation 6

CO₂eEstablishment, RP	9.21	3.84	13.05	9.21	3.84	Modeled based on material use, amortized on monthly basis
CO₂eOperations, RP	138.34	133.82	272.16	138.34	133.82	Alkalinity production and transport, personnel transport and accommodations, operations and monitoring
CO₂eEnd-of-Life, RP	3.77	0	3.77	3.77	0	Combined with establishment emissions
CO₂eLeakage, RP	0	0	0	0	0	No leakage expected – See Table 6
Uncertainty Discount	105.75	112.35	168.10 ²	104.80	63.30	Propagated uncertainty from gross CDR and LCA

¹ Values have been rounded and may not add up without error. Units are tonnes CO₂e unless otherwise noted

² See error propagation is based on the uncertainties in ROMS and ECCO for the two dosing periods. These are not independent uncertainties so standard error propagation formulas are not used.

Appendix 3: Files Reviewed

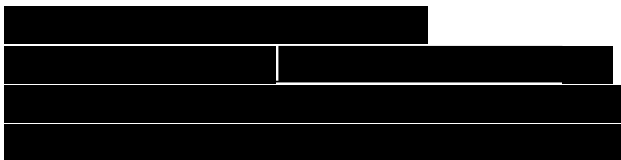
IS2403 - Planetary Nova Scotia Verification Report V1.3_Signed.pdf
IS2403 - Planetary Nova Scotia Validation Report V1.2.pdf
Nova Scotia Environment Act.pdf
Planetary_regulatory_pathway_Tufts_Cove.pdf
Copy of Planetary Environmental Analysis_091322.pdf
Copy of Planetary Environmental Analysis_approval_13Dec22.pdf
Copy of DG_Approval_cover_letter_05Sep23.pdf
Copy of DG_Approval_document_05Sep23.pdf
Copy of Application_2023-3366981_additional_information_20Jul23.pdf
Copy of Dangerous Goods Application acknowledgement_#2023- 3366981-00.pdf
Copy of Enclosure 1 - Application_2023-3366981_additional_information_21Aug23.pdf
Copy of Enclosure 5 - Planetary_Technologies_TC_contingency_plan_15Aug23_v3_signed.pdf
Copy of NS_ECC_Request for Additional Information Letter_12Jul23.pdf
Copy of Planetary_OAE_DG_application_07Jun23.pdf
Copy of DG_Amendment_Cover Letter_27May24.pdf
Copy of DG_Amendment_approval_17Ma24.pdf
Copy of Planetary_Technologies_2023-3366981-00_amendment_request_v2_29Feb24.pdf
Planetary - First Amending Agreement_signed_22May24.docx (1).pdf
Planetary Nova Scotia Power License Agreement 6521.9676 dual signature (2).pdf
Copy of Average Bag Weights.xlsx
Planetry PDD update TC25.1.pdf
TC24 Ops&Monitoring Report.pdf
TC25.1 Isometric GHG Statement Report V1.pdf
TC25.1_Ops-&-Monitoring-Report.pdf
Cumulative_Energy_Draw_Log_ACTIVE.xlsx
Detailed Dosing Log - FOR VERIFICATION ONLY.xlsx
Fuel_log_ACTIVE.xlsx
Ocean_ecotransit_world_Calculation_Result_20250603.pdf
Train_ecotransit_world_Calculation_Result_20250603 (2).pdf
Truck_ecotransit_world_Calculation_Result_20250603 (1).pdf

CEOTR_Invoice_2025_001.pdf
OrderExport-53440.txt
OrderExport-53441.txt
OrderExport-53446.txt
OrderExport-53565.txt
OrderExport-53673.txt
OrderExport-53779.txt
OrderExport-54280.txt
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OrderExport-54450.txt
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OrderExport-55489.txt
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OrderExport-62535.txt
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OrderExport-63502.txt
OrderExport-63613.txt
OrderExport-63658.txt
OrderExport-63812(1).txt
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OrderExport-63846.txt
OrderExport-63989.txt
OrderExport-64011.txt
OrderExport-64111.txt
OrderExport-64159.txt
OrderExport-64200.txt
OrderExport-64229.txt
OrderExport-64260.txt
OrderExport-64336.txt
OrderExport-64483.txt
OrderExport-64487.txt
OrderExport-64595.txt
OrderExport-64684.txt
OrderExport-64707.txt
OrderExport-64723.txt
OrderExport-64735.txt
OrderExport-64736.txt
OrderExport-64737.txt
OrderExport-64759.txt
ReceiverExport-64317.txt
ReceiverExport-64318.txt
ReceiverExport-64352.txt
ReceiverExport-64354.txt
ReceiverExport-64467.txt
ReceiverExport-64468.txt
ReceiverExport-64469.txt
ReceiverExport-64470.txt
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ReceiverExport-64472.txt
ReceiverExport-64724.txt

ReceiverExport-64725.txt
ReceiverExport-64726.txt
ReceiverExport-64727.txt
ReceiverExport-64728.txt
ReceiverExport-64729.txt
Copy of Refuel 09_04_2025.pdf
Copy of Refuel 16_05_2025.pdf
Copy of Refuel 23_04_2025.pdf
Copy of Refuel 31_03_2025.pdf
Dispute case 100064889 received.pdf
HFXR81761.pdf
Planetary_PO_1144_-_Scan_Global_Logistics.pdf
SGLF25_013279.pdf
SGLF25_013282.pdf
SGLF25_013285.pdf
ZIMUBCN10176881 demurrage invoice.pdf
scan_global_logistics_2025-01-02_2064.26.pdf
scan_global_logistics_2025-01-08_166404.80.pdf
scan_global_logistics_2025-01-27_72127.65.pdf
scan_global_logistics_2025-04-07_36447.48.pdf
scan_global_logistics_2025-04-09_36447.48.pdf
scan_global_logistics_2025-04-30_37393.37.pdf
scan_global_logistics_2025-05-20_37362.95.pdf
scan_global_logistics_2025-05-26_33563.56.pdf
scan_global_logistics_2025-05-28_3950.00.pdf
scan_global_logistics_2025-06-02_4100.00.pdf
INVOICE PLANETARY.pdf



Updated Planetary_PO_1097.pdf
Feb_25 Invoice_93281_from_Trebley_Logistics_Ltd.pdf
Invoice # TREBL_R105107.pdf
Invoice_93180_from_Trebley_Logistics_Ltd.pdf
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Trebley Logistics_2025-01-30_93158.pdf
Trebley Logistics_2025-01-30_93159.pdf
Trebley Logistics_2025-01-30_93160.pdf
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Trebley Logistics_2025-01-30_93174.pdf
Trebley Logistics_2025-01-30_93175.pdf
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HA2500347_0_XLR.xlsx
HA2500533_0_XLR.xlsx
HA2500944_1_XLR.xlsx
HA2501034_1_XLR .xlsx
HA2501393_0_XLR.xlsx

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Planetary IA 2023-3366981-01 Extension to Dec 6 2025 (1).pdf
Planetary Incident Tracker.xlsx
Planetary NSE correspondence.zip
Trebley Scale Calibration 2025-09-23.pdf
ocean_metals_new.csv
outfall_metals.csv
sediment_metals.csv
dosing_2025-02.csv
dosing_2025-03.csv
dosing_2025-04.csv
dosing_2025-05.csv
dosing_2025-06.csv
VuSitu_Calibration_1100321_2025-01-15.gdoc
VuSitu_Calibration_1100321_2025-03-10.html
VuSitu_Calibration_1100321_2025-03-12.csv
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Discrete Sample Summary(Data Summary 2025).csv
PT-ALK-ALL_24July2025.ods
pH-Planetary_ALL_7Jan.xlsx
ctd_raw.csv
downstream_sensorbox_raw.csv
mooring_TA_sensor_raw.csv
mooring_co2_raw.csv
mooring_sonde_raw.csv
TC25.1 Isometric GHG Statement Report.pdf
gss_1K6BAA5RD1S0FEZE.xlsx
ECCO_model_validation_-_source_file_for_far-field_CDR.pdf
CDR_quantification_-_TC25.1.pdf
EQOH_20250201_to_20250630_-_source_file_for_EQOH.xlsx
Daily_Dosing_Totals.xlsx
Detailed_Dosing_Log.xlsx
Submitted_Copy_LCA__2025_tc25_1-_FOR_VERIFICATION_ONLY_.xlsx
TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
TC24 LCA Emissions Statement.pdf
TC24_EQOH_data_2024_to_Jan_2025.xlsx
TC24_CDR_quantification_-_May25.pdf
TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
TC24 LCA Emissions Statement.pdf
TC24_EQOH_data_2024_to_Jan_2025.xlsx
TC24_CDR_quantification_-_May25.pdf
CV-lzettR_2025.09.pdf
Halifax SensorBox QAQC protocols.pdf
Planetary NSE correspondence.zip

NSE Confirmation of Receipt_Anomalous concentrations of mercury and copper in seawater observed - 315
Windmill Rd, Dartmouth (2).eml
NSE July & August Operational Report (Planetary) 2024.eml
NSE Notification - Anomalous concentrations of mercury and copper in seawater observed - 315 Windmill Rd,
Dartmouth.eml
NSE submission_Planetary - 2024_5 Operations Report.eml
Copy of Average Bag Weights.xlsx
TC25.1 monitoring data for 350.pptx
mooring_bottle.csv
ocean_bottle.csv
ocean_ctd.csv
ocean_metals.csv
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ocean_mooring_pCO2_2025-04.csv
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ocean_mooring_pCO2_2025-06.csv
ocean_mooring_sonde_2025-02.csv
ocean_mooring_sonde_2025-03.csv
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ecco_daily_co2_fluxes_TC25_1_Halifax_20120331_20140601.csv
h2_TC25_1_tracers_202502-003.nc
h2_TC24F_tracers_202407-001.nc

Appendix 4: Verifier Qualifications

350Solutions, Inc. Corporate Experience

350Solutions serves as an independent expert in cleantech, low carbon, and environmental technologies. We provide an unbiased assessment of innovative technologies. 350Solutions is accredited through ANAB under ISO 17020 as an independent inspection body to provide independent technology evaluation services using the ISO 14034 ETV process. In addition, 350Solutions staff include a Certified Measurement and Verification Professional (CMVP for IPMVP) and a North Carolina Registered Professional Engineer (P.E.).

Zoe Sandwith
Research & Verification Associate, 350Solutions

EDUCATION:

BSc. Combined Biology & Earth Science, University of Victoria, 2011

EXPERIENCE SUMMARY:

Zoe Sandwith is an observational ocean scientist with expertise in ocean chemistry, biogeochemical cycles, oceanographic instrumentation, and field- and lab-based analytical methodologies. Zoe works on verifying carbon dioxide removal (CDR) technologies, with a focus on marine and open systems. Previously, Zoe conducted academic research on topics including: dissolved oxygen in dynamic coastal settings and constraining the error associated with different measurement techniques; the use of dissolved oxygen isotopes for understanding net community productivity and potential export efficiency; the analysis of the marine carbonate cycle and ocean acidification; and the development and testing of novel instrumentation. In addition to her research, Zoe has experience managing large, long-term observational research infrastructure at the marine interface.

SELECTED RESEARCH AND PROFESSIONAL EXPERIENCE:

Jun 2025 – Present: Research & Verification Associate, 350Solutions

Verify CDR technologies on behalf of registries and individual clients. Specializes in marine and open system pathways, instrumentation, carbonate system chemistry, and data quality

2021-2024: Scientist, Hakai Institute. Analyzed high-frequency, high resolution oceanographic data from field programs and autonomous platforms and synthesized in a regional context. Focused on dissolved oxygen dynamics, regional hypoxia, ocean acidification, and climatological linkages. Participated in field monitoring programs and developed and trialed low-cost autonomous sensors and sampling platforms.

2011-2020: Manager & Research Assistant III, Woods Hole Oceanographic Institution. Managed daily operations for the Martha's Vineyard Coastal Observatory and spearheaded infrastructure retrofit and upgrades and permitting review. Conducted research on biogeochemical cycles using gas tracers, specializing in dissolved oxygen isotopes and the dissolved oxygen to argon ratio for measuring Net Community Production, as well as high quality analysis of the isotopes of the nitrogen cycle and carbonate system. Operated in open and coastal ocean, estuarine, lacustrine and marsh systems. Managed multiple analytical laboratories.

SELECTED PUBLICATIONS:

Evans W, Campbell K, Weekes C, [...] **Sandwith Z**, and Jackson J. 2025. Variability in Storm season intensity modulates ocean acidification conditions in the northern Strait of Georgia. *Nature Sci Reports* 15(4505). <https://doi.org/10.1038/s41598-025-88241-8>

•Nicholson D, Michel APM, [...] **Sandwith Z**, Monk S. 2018. Rapid mapping of methane and carbon dioxide in coastal ecosystems using the ChemYak, an autonomous surface vehicle. *Env Sci Tech*. <https://doi.org/10.1021/acs.est.8b04190>

Lily Schacht
Carbon Removal Verification Engineer, 350Solutions

EDUCATION:

MS, Environmental Engineering, University of Wisconsin – Madison, 2019

BS, Chemical, Energy, and Environmental Engineering, Washington University in St. Louis, 2017

EXPERIENCE SUMMARY:

Lily Schacht is an Environmental and Chemical Engineer with experience in process engineering, environmental chemistry, analytical methods, and life cycle analysis (LCA). At 350Solutions, Lily works on verifying carbon dioxide removal (CDR) technologies, with a focus on mineralization-based pathways, including enhanced weathering, direct air capture, and ocean alkalinity enhancement. Previously, Lily led agronomic research at an enhanced weathering CDR supplier where she organized field trials across multiple states to quantify carbon removal and crop yield changes after rock application. Before that, Lily developed rapid prototyping instrumentation to optimize a biomineralization process in concrete production and aided in scaling up the process to pilot-scale. Lily also built environmental impact models for process variable sensitivity analysis of demo-scale manufacturing processes. These models were used to drive the direction of research and development to minimize product life cycle impacts. Throughout her career, Lily has developed analytical chemistry methodologies for both liquid- and solid-phase analyses.

RESEARCH AND PROFESSIONAL EXPERIENCE:

March 2024 – Present: Carbon Removal Verification Engineer, 350Solutions

Verify CDR technologies on behalf of registries and the XPRIZE Carbon Removal challenge. Specializes in mineralization pathways, including mineralization kinetics, measurement methods, and open-system modeling.

Nov 2022 – Feb 2024: Researcher, Lithos Carbon

Quantified carbon removal rates and agronomic impacts of enhanced weathering on cropland across six US states; Evaluated chemical analysis methods for precision relative to cost.

Nov 2023 – Jan 2024: Independent Consultant, Keel Labs

Built an environmental impact model to evaluate potential material and process changes; Recommended areas for reducing material usage up to 80%

Dec 2020 – Oct 2022: Research Scientist II, Biomason

Guided experimentation and data analysis throughout all R&D teams to inform techno-economic analysis (TEA) and LCA; built and led the carbonate biomineralization prototyping workstream for rapid iteration; developed real-time measurement techniques for critical process parameters in solid state

SELECTED PUBLICATIONS & PRESENTATIONS:

- **Schacht, L.,** Baum, M., Liu, H., & Yap, M. (2023) Scaling Enhanced Rock Weathering: Agronomic Impacts at Field-Scale [[Abstract](#)]. ASA, CSSA, SSSA International Annual Meeting, St. Louis, MO.
- **Schacht, L.** and Ginder-Vogel, M. Arsenite Depletion by Manganese Oxides: A Case Study on the Limitations of Observed First Order Rate Constants. *Soil Syst.* 2018, 2(3), 39.
<https://doi.org/10.3390/soilsystems2030039>

Veronica Tamsitt

EDUCATION

Ph.D. Oceanography, Scripps Institution of Oceanography, UC San Diego, 2018
Thesis: Aspects of the three-dimensionality of the Southern Ocean Overturning Circulation
B.Sc. Oceanography with Honors, University of Washington, 2012
Thesis: Nitrous Oxide in the eastern tropical North Pacific

EXPERIENCE

Submarine PBC – Remote 2023 –
Co-founder and Head of Oceanography
University of South Florida – St Petersburg Florida/Remote 2021 – 2023
Research Scientist
University of New South Wales and Centre for Southern Hemisphere Oceans Research CSIRO Oceans and Atmosphere – Australia / Remote 2018 – 2021
Postdoctoral Research Associate
Scripps Institution of Oceanography, UCSD – San Diego, CA 2012 – 2018
Graduate Student Researcher
Stable Isotope lab, University of Washington,
Department of Oceanography – Seattle, Washington 2010 – 2012
Undergraduate Student Researcher

SELECTED PUBLICATIONS

Dawson, H. R., England, M. H., Morrison, A. K., **Tamsitt, V.**, & Fraser, C. I. (2024). Floating debris and organisms can raft to Antarctic coasts from all major Southern Hemisphere landmasses. *Global change biology*, 30(8), e17467.
Bach, L. T., **Tamsitt, V.**, Baldry, K., McGee, J., Laurenceau-Cornec, E. C., Strzepek, R. F., ... & Boyd, P. W. (2023). Identifying the Most (Cost-) Efficient Regions for CO₂ Removal With Iron Fertilization in the Southern Ocean. *Global Biogeochemical Cycles*, 37(11).
Tamsitt, V. (2023). New insights into air-sea fluxes and their role in Subantarctic Mode Water formation. *Philosophical Transactions of the Royal Society A*, 381(2249).
Xie, Y., **Tamsitt, V.**, & Bach, L. T. (2022). Localizing the southern ocean biogeochemical divide. *Geophysical Research Letters*, 49(8), e2022GL098260.
Bach, L., **V. Tamsitt**, J. Gower, C. L. Hurd, J. A. Raven, P. W. Boyd (2021). Testing climate intervention with ocean afforestation using the Great Atlantic Sargassum Belt. *Nature Communications*, 12(1), 1-10. **V. Tamsitt**
(2018). Moving Windows to the Deep Ocean. *Nature Climate Change*, 8(11), 941-942
Tamsitt, V., H. Drake, A. K. Morrison, L. D. Talley, C. O. Dufour, A. R. Gray, S. M. Griffies, M. R. Mazloff, J. L. Sarmiento, J. Wang, And W. Weiher, (2017). Spiraling Pathways Of Global Deep Waters To The Surface Of The Southern Ocean. *Nature Communications*, 8, 172.

SELECTED CONFERENCE & WORKSHOP PRESENTATIONS

V. Tamsitt, 2022. *Invited panelist on marine Carbon Dioxide Removal permanence*, Ocean Carbon and Biogeochemistry Marine Carbon Dioxide Removal Measurement Reporting and Verification (mCDR MRV) Workshop, University of Rhode Island, USA
V. Tamsitt, 2022. *New understanding of air-sea fluxes and their role in water mass formation*, Invited oral presentation, Royal Society Discussion Meeting on Southern Ocean heat and carbon uptake, London, UK

GRANTS AND FUNDING

Collaborative Research: Diagnosing the role of ocean eddies in carbon cycling from a high resolution data-assimilating ocean biogeochemical model

NSF Office of Polar Programs, co-Investigator changed to Principal Investigator
Amount: \$288,000 | Duration: 2022 - 2025

The Role of Cyclonic Upwelling Eddies in Southern Ocean CO₂ Flux

NSF Office of Polar Programs, co-Investigator
Amount: \$1.1M | Duration: 2021 - 2024

Biogeochemical Argo synthesis products of oxygen, nitrate, and pH for increased community utilization of autonomous profiling observations

NOAA Climate Program Office, co-Investigator
Amount: \$130k | Duration: 2021- 2024