BLUE CARBON AND WETLANDS COMPENSATORY MITIGATION: FITTING A CLIMATE-SIZED PEG INTO A WATERSHED-SIZED HOLE

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This Article seeks to provide policymakers and coastal resource managers with detailed insights into the challenges and opportunities for incorporating considerations of "blue carbon" into compensatory mitigation required under Clean Water Act Section 404. As our understanding of blue carbon systems deepens, so too does the urgency of responding to the global climate crisis. Commentators have encouraged the inclusion of blue carbon into existing domestic policies, including Clean Water Act Section 404. It is the authors' hope that focused articles such as this can shine a light on which approaches might be most tenable under existing law, directing efforts towards workable solutions.

I. INTRODUCTION

As global efforts to mitigate climate change intensify, the ability of natural resources to sequester and store carbon has received much attention. Some natural systems can remove carbon dioxide from the atmosphere and store it for some time. In recent years, scientific research has identified a category of natural system that has significant sequestration and storage potential: coastal blue carbon.[3] (Throughout this article, we utilize the term "storage" to refer to blue

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[3] The term "blue carbon" may also be used to refer to carbon captured by the world's oceans. *See* *What is Blue Carbon?*, NOAA NAT'L OCEAN SERV. (Aug. 24, 2023). In this article we focus on carbon captured by coastal ecosystems.

carbon systems' ability to not only sequester carbon dioxide from the atmosphere, but also potentially store it for geologically significant periods of time.)[4]

Coastal blue carbon typically refers to three types of coastal ecosystems: mangrove forests, seagrass beds, and tidal marshlands. These systems, which are all found in the U.S., are important carbon sinks and can store carbon at much higher rates than terrestrial forests.[5] They can also provide a wide variety of other services, including community protection from storms, provision of habitat and resources for species, water quality improvements, social and cultural values, and other benefits.[6] In the U.S., policy makers and other actors have incorporated coastal blue carbon into a variety of climate-related actions in recent years, including swelling scientific research,[7] the National Climate Assessment,[8] proposed legislation,[9] carbon offsetting methodologies,[10] and other activities.

In the U.S., many existing statutes are in some way related to coastal blue carbon resources.[11] Commentators have broadly examined ways that these laws can protect or improve the carbon storage potential of coastal blue carbon systems, whether through conservation, restoration, or other means. One potential

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[4] *See* *Coastal Blue Carbon*, NOAA NAT'L OCEAN SERV. (Aug. 16, 2023) (describing the difference between carbon sequestration – the process of capturing carbon dioxide from the atmosphere – and carbon storage – the long-term confinement of carbon in plant materials or sediment). *But see* Sophia Johannessen & James Christian, *Why blue carbon cannot truly offset fossil fuel emissions*, 4 Communications Earth & Env't 411 (2023) (describing a communications gap concerning the timescale differences involved when coastal blue carbon, part of the dynamic modern carbon cycle, is described as offsetting the introduction of ancient fossil fuels into the modern carbon cycle).
[5] *See* Christine Bertram et al., *The blue carbon wealth of nations*, 11 Nature Climate Change 704-709 (2021).
[6] *See* Christine L. May et al., *Focus on Blue Carbon*, in *Fifth National Climate Assessment* (Crimmins, A.R. et al., eds. 2023).
[7] *See, e.g.*, Chongming Zhong et al., *A systematic overview, trends and global perspectives on blue carbon: A bibliometric study* (2003-2021), 148 Ecological Indicators 110063 (2023).
[8] May et al., *supra* note 6.
[9] Blue Carbon for Our Planet Act, H.R. 2750, 117th Congress (2021-2022); Blue Carbon Protection Act, H.R. 3906, 117th Congress (2021-2022).
[10] *See, e.g.*, VERRA, METHODOLOGY FOR TIDAL WETLAND AND SEAGRASS RESTORATION (VM0033), Version 2.1 (2023).
[11] *See* Adam Orford, *Blue Carbon Law*, 13:1 SEA GRANT L. & POL'Y J. 9 (2024).

tactic recommended by some is the inclusion of carbon metrics into compensatory mitigation standards under Section 404 of the Clean Water Act.

Topically speaking, including carbon into Section 404 mitigation standards appears appropriate. Section 404 requires permits for many physical impacts to U.S. waters, including coastal waters, and permittees must compensate for the impacts they cause, typically through restoration of another resource of the same kind in the same watershed. The amount of mitigation required is determined by measuring aquatic functions lost at an impact site. Requiring permittees and mitigation project developers to also measure the carbon storage function lost and gained at impact and mitigation sites, respectively, could help ensure Section 404 does not inadvertently compromise the net carbon storage services of our nation's coastal blue carbon systems.

A closer examination, however, reveals serious challenges to the incorporation of carbon storage metrics into Clean Water Act Section 404. Here, we have identified three. First, it is entirely possible that courts examining the inclusion of carbon storage into the Section 404 program through a separation of powers lens could find that Congress clearly did not intend for the program to cover emissions of carbon dioxide or other greenhouse gases. On this question, we examine both the inclusion of carbon in Section 404 under the lens of existing doctrine and note trends and forthcoming rulings at the U.S. Supreme Court that may make such inclusion even less likely. Second, rules developed for the Section 404 program include a pervasive practicability qualifier that could disqualify data-intensive comprehensive carbon storage analyses. Finally, we note that the decentralized nature of the U.S. Army Corps of Engineers, which administers the Section 404 program, would likely act as a barrier to incorporating carbon storage at a nationwide scale.

Despite these challenges, there may be other methods for protecting the carbon storage values of coastal blue carbon systems through Clean Water Act Section 404. Here, we describe four. First, we note that the National Environmental Policy Act may be an avenue for including carbon storage into Section 404 permitting decisions. Second, we discuss inexact proxies for carbon storage that could be permissible as Section 404 mitigation metrics. Third and fourth, we describe the use of in-kind mitigation and higher mitigation ratios, both provided for by Section 404 regulations, to require more mitigation for coastal blue carbon systems and, presumably, protect against a net loss of carbon storage values.

II. COMPENSATORY MITIGATION UNDER CLEAN WATER ACT SECTION 404

The primary purpose of the Clean Water Act (CWA) is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters."[12] Among other regulatory programs the CWA established to achieve this goal, Section 404 regulates the discharge of dredge or fill material into U.S. waters, including many blue carbon systems.[13] These aquatic resources "perform critical ecological functions in the landscape, including protecting water quality, regulating water quantity and flows, and providing important habitat for fish and wildlife."[14] By requiring permits for discharges of dredge or fill material – which covers many physical impacts to aquatic resources associated with development and other activities – Section 404 helps to protect important aquatic resource functions and support the purpose of the CWA.

The U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) share responsibility for the Section 404 program, with permitting authority vested in the Corps.[15] When issuing permits, the Corps must abide by what are known as the "Section 404(b)(1) Guidelines."[16] Under the 404(b)(1) Guidelines' "sequencing" approach, the Corps must first avoid impacts

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[12] 33 U.S.C. § 1251(a).
[13] *Id.* § 1344. The recent Supreme Court decision in Sackett v. EPA has greatly limited the scope of the CWA, *Sackett v. EPA*, 598 U.S. 651 (2023). Impacts to blue carbon resources may, however, be limited as the opinion appears to retain CWA coverage over tidally influenced waters. *Id.* at 678-79.
[14] Palmer Hough & Rachel Harrington, *Ten Years of the Compensatory Mitigation Rule: Reflections on Progress and Opportunities*, 49 ENV'T L. REP. NEWS & ANALYSIS 10018 (2019).
[15] 33 U.S.C. § 1344(d).
[16] 33 C.F.R. Part 332; 40 C.F.R. Ch. 1, Subch. H, Pt. 230 (2024). *See also* J.B. Ruhl & James Salzman, *No Net Loss? The Past, Present, and Future of Wetlands Mitigation Banking*, 73 CASE W. RES. L. REV. 411, 417 (2022).

to the aquatic resource at issue, then minimize unavoidable impacts.[17] Finally, the Corps is required to ensure that compensatory mitigation is provided for any remaining impacts.[18] Required mitigation is either incorporated into Section 404 permits by reference to an approved mitigation plan or included as permit conditions.[19]

Before proceeding with a brief overview of the nuts and bolts of the mitigation program, it may be useful to briefly explain how mitigation works in layperson's terms. Generally speaking, compensatory mitigation under CWA Section 404 is accomplished through data collection and measuring. Prospective permittees measure their proposed impacts to an aquatic resource, depending on data required by their Corps district's mitigation standards. Through those standards, these measured data will translate into a certain amount and kind of mitigation the permittee must perform (or pay for) at a certain general location (i.e., mitigation debits accrued). As noted below, this mitigation requirement is incorporated into the Section 404 permit. On the other side of the equation, mitigation project providers also collect data and measure the resource improvements of their projects, which are translated through a Corps district mitigation program into credits that can be used to satisfy Section 404 permit mitigation requirements. Commentators advocating for inclusion of carbon storage into CWA Section 404 standards are, in essence, asking for measurement of another parameter at permit and mitigation sites that will impact the amount of mitigation debits and credits permittees and mitigation providers will accrue, respectively. This could, in theory, ensure that Section 404 permits do not result in a net loss of carbon storage.

[17] 33 C.F.R. § 332.1(c)(2); 40 C.F.R. § 230.91(c)(2).
[18] 33 C.F.R. § 332.1(c)(2); 40 C.F.R. § 230.91(c)(2). Compensatory mitigation is supposed to ensure that the national policy of "no net loss" of wetlands is met. *See* Ruhl & Salzman, *supra* note 16. *See also* Katie Hill et al, *No Net Loss in the U.S. Army Corps Savannah District* 10 (Georgia Environmental Restoration Assoc. 2017).
[19] 33 C.F.R. § 332.4(c)(1); 40 C.F.R. § 230.94(c)(1). For compensatory mitigation required pursuant to a general permit – a class of Section 404 permit for activities that have minimal adverse effects and issued according to an expedited process – a third option exists for the district engineer to approve a conceptual or detailed plan to meet required time frames. Before the permittee begins work covered by the permit, a final plan must be approved by the district engineer. 33 C.F.R. § 332.4(c)(1)(ii).

Mitigation standards – how much mitigation each Section 404 permittee must conduct and how it will be measured, what counts as a valid mitigation project, and other policies – are established by each of the Corps' 39 districts according to national guidelines (see Section IV.C, below). These guidelines are found in the 2008 Compensatory Mitigation Rule (2008 Rule),[20] developed jointly by the Corps and EPA.[21] The 2008 Rule states that compensatory mitigation may be accomplished by restoring, establishing (i.e., creating), enhancing, or preserving aquatic resources, preferably the same kind as those impacted (i.e., "in-kind" mitigation), and preferably in the same watershed in which impacts occur.[22] A Section 404-permitted project that fills in a coastal marsh in the Altamaha River watershed in coastal Georgia could, for example, be compensated for by restoring another marsh in that watershed. The Corps can require higher mitigation-to-impact ratios in a number of circumstances, including for difficult-to-replace resources[23] or when mitigation of lost functions occurs after permitted impacts (otherwise known as "temporal loss").[24] In our example, if the marsh impacted was difficult to replace, or if the aquatic functions lost at the impact site were restored at the mitigation site after the permitted impacts occurred, the permittee could be required to restore more acres of marsh.

The 2008 Rule requires that all compensatory mitigation projects have "objective and verifiable" ecological performance standards that "may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position."[25] A marsh mitigation project recently approved in coastal Georgia, for example, is governed by four vegetative and three hydrologic

[20] 40 C.F.R. §§ 230.91-98; 33 C.F.R. § 332.
[21] *See* Hough & Harrington, *supra* note 14.
[22] 33 C.F.R. § 332.3; 40 C.F.R. § 230.93.
[23] 33 C.F.R. § 332.3(e)(3); 40 C.F.R. § 230.93(e)(3).
[24] 33 C.F.R. § 332.3(f)(2); 40 C.F.R. § 230.93(f)(2).
[25] 33 C.F.R. § 332.5(b); 40 C.F.R. § 230.95(b).

performance standards.[26] The 2008 Rule also requires monitoring to determine if performance standards are being met.[27]

III. COASTAL BLUE CARBON STORAGE ANALYSES

As this article focuses on whether carbon storage can be incorporated into CWA Section 404 mitigation metrics, a basic understanding of what a carbon storage analysis entails is appropriate. Storage by coastal blue carbon systems is a product of biologic carbon sequestration, whereby plants turn atmospheric carbon dioxide into biomass which then persists for long time periods as either woody products or detritus in soils.[28] There are three primary reasons why coastal blue carbon systems have the potential to be significant carbon sinks. First, coastal blue carbon plants have generally high productivity (i.e., fast growth), sequestering a lot of carbon dioxide in the process.[29] Second, plant detritus accumulates rapidly and decomposes very slowly in soils because, in part, the soil environment is largely anaerobic (without oxygen); this allows plant carbon to persist for hundreds or even thousands of years.[30] Third, regular inundation with sulfate-rich seawater means that these systems emit negligible methane[31] (an issue with their freshwater counterparts).

Although coastal blue carbon systems have *the potential* to store large amounts of carbon, the exact amount stored in a particular system is highly site

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[26] MAPACHE, LLC, BANKING INSTRUMENT ISLA DE MAPACHE MITIGATION BANK, CAMDEN COUNTY, GEORGIA 16 (2023).
[27] 33 C.F.R. § 332.6(a)(1); 40 C.F.R. § 230.96(a)(1). Monitoring for the Georgia marsh mitigation project referenced here is primarily conducted with drones and automated data recorders. MAPACHE, LLC, *supra* note 26.
[28] *Frequently Asked Questions, What's the difference between geologic and biologic carbon sequestration?*, U.S. GEOLOGICAL SURV. (USGS) (last visited Feb. 22, 2024).
[29] *Coastal Blue Carbon*, *supra* note 4.
[30] *Id.*
[31] *See* REBECCA SANDERS-DEMOTT ET AL., USGS DATA RELEASE, CARBON DIOXIDE AND METHANE FLUXES WITH SUPPORTING ENVIRONMENTAL DATA FROM COASTAL WETLANDS ACROSS CAPE COD, MASSACHUSETTS (2022).

specific.[32] Coastal wetlands are incredibly dynamic, and their connection to both inland waters and marine systems means that scientifically rigorous carbon storage analyses must examine the "mass balance" of the system, i.e., how much carbon is going into the system, how much is stored in the system, how much is going out into the atmosphere, and how much of that carbon is stored elsewhere.[33] This entails examining factors such as aboveground biomass (i.e., plants), stored soil carbon,[34] emissions of other greenhouse gases from the system, such as methane,[35] and lateral fluxes (how much carbon is coming into the system from upland sources such as sediment in creeks and rivers and how much is leaving the wetland to become part of the marine environment).[36] (There are, however, methods for estimating some of the vital components of a comprehensive carbon storage analysis that are simpler and less expensive to conduct. We discuss the potential for incorporating two of these in Section V.B, below).

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[32] *See* Carson Miller et al, *Carbon accumulation rates are highest at young and expanding salt marsh edges*, 3 COMMUNICATIONS EARTH & ENV'T 173 (2022) (showing a range of 14-323 g C m^{-2} yr^{-1} at seven salt marsh sites in North Carolina and noting that "the large range of salt marsh [carbon accumulation rates] creates uncertainty in upscaling measurements, monetizing carbon credits, appraising the value of restoration and conservation projects, and would add speculation to the carbon market").

[33] *See* Forbrich, I., A. E. Giblin, & C. S. Hopkinson, *Constraining Marsh Carbon Budgets Using Long-Term C Burial and Contemporary Atmospheric CO2 Fluxes*, 123 J. GEOPHYS. RES. BIOGEO. 867 (2018). *See also* WETLAND CARBON AND ENVIRONMENTAL MANAGEMENT (Ken W. Krauss et al. eds., 2022).

[34] *See* Amanda Spivak et al, *Global-change controls on soil-carbon accumulation and loss in coastal vegetated ecosystems*, 12 NATURE GEOSCIENCE 685 (2019) (noting that the uncertainty surrounding disturbance effects on soil organic carbon in blue carbon ecosystems "makes it difficult to predict [their] sustainability … and incorporate them into global budgets and management tools," and proposing a conceptual framework to improve predictions of blue carbon soil organic carbon storage).

[35] Methane and other GHG emissions may be reduced due to increased salinity or changing land use at project sites. *See* VERRA, METHODOLOGY FOR TIDAL WETLAND AND SEAGRASS RESTORATION (VM0033), Version 2.0 (2021).

[36] *See* Forbrich, Giblin & Hopkinson, *supra* note 33. *See also* WETLAND CARBON AND ENVIRONMENTAL MANAGEMENT, *supra* note 33.

IV. CHALLENGES TO INCORPORATING CARBON INTO CLEAN WATER ACT SECTION 404

Coastal blue carbon systems can store a significant amount of carbon, and some commentators have suggested that carbon storage should be included as a variable in Corps standards governing Section 404 compensatory mitigation.[37] They note that compensatory mitigation is based on the accrual of aquatic functions that "represent the chemical, biological, and physical integrity of a wetland,"[38] the mitigation rule requires "performance criteria based on the ecological performance of the site,"[39] and carbon "clearly is an important component and characteristic of both soils and vegetation."[40] Because carbon storage is a function that could take some time to restore at mitigation sites, they argue that higher compensation ratios could be justified to account for temporal loss.[41]

Although a laudable goal, incorporating carbon storage into Section 404 mitigation standards may be a rather complicated affair. Legal principles and practical considerations unearth several challenges: separation of powers principles, the mitigation program's focus on practicability, and the decentralized nature of the Corps. We discuss each of these challenges below.

A. Separation of Powers

The first challenge to incorporating carbon storage into mitigation metrics is that a court may find this is not a power authorized by the CWA. This question originates in separation of powers principles enshrined in the U.S. Constitution.

The constitutional principle of separation of powers prohibits federal agencies from acting outside of the authorities granted to them by Congress via

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[37] Linwood Pendleton et al, *Considering "Coastal Carbon" in Existing U.S. Federal Statutes and Policies*, 41 COASTAL MGMT. 439, 445 (2013); *see* ALSO RESTORE AMERICA'S ESTUARIES, A NATIONAL BLUE CARBON ACTION PLAN: OPPORTUNITIES AND RECOMMENDATIONS 8 (2022).
[38] Pendleton et al., *supra* note 37, at 445.
[39] *Id.*
[40] *Id.*
[41] *Id.*

statute.[42] The constitution lays out clear and distinct roles for each branch of government, and it is only the legislative branch – Congress – that may set national policies via the adoption of law.[43] The executive branch, which includes federal agencies, is limited to executing policy when given authority under the law.[44] Over the course of our nation's history, numerous disputes have arisen concerning an agency's interpretation of its statutory powers. When these disputes arise, courts are the final arbiters concerning what authorities a statute confers.[45]

When considering the statutory authority of an agency, courts use principles of statutory construction to determine what Congress intended, and will strike down clearly contrary agency interpretations[46] If the intent of Congress is clear, it "is the end of the matter,"[47] and the court and agency "must give effect to the unambiguously expressed intent of Congress."[48] In the case of an ambiguous statute, where the question of whether Congress meant to provide an agency with a particular power is less than clear, existing legal doctrine requires courts to defer to the agency's reasonable interpretation.[49]

Separation of powers considerations pose potentially significant challenges for incorporating carbon storage into CWA Section 404 compensatory mitigation standards. Convincing a court that Congress clearly intended to give EPA and the Corps (or individual Corps districts; see Sec. IV.C, below) power to include carbon storage in compensatory mitigation standards could be a tough row to hoe. If congressional intent on the matter was deemed ambiguous, there is also a real possibility that such an agency interpretation could be deemed unreasonable. Furthermore, the recent tenor of Supreme Court cases suggests that

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[42] *See* Whitman v. American Trucking Assoc., 531 U.S. 457 (2001). Separation of powers principles also prohibit Congress from delegating its legislative powers to agencies or the courts. *See* A.L.A. Schechter Poultry Corp. v. United States, 295 U.S. 495, 529 (1935).
[43] U.S. CONST. art. I, § 1.
[44] U.S. CONST. art. II, § 2.
[45] Fed. Election Comm'n v. Democratic Senatorial Campaign Comm., 454 U.S. 27, 32 (1981).
[46] *Id.* (noting that "the courts are the final authorities on issues of statutory construction [and] must reject [agency] constructions of the statute, whether reached by adjudication or rule-making, that are inconsistent with the statutory mandate or that frustrate the policy that Congress sought to implement").
[47] Chevron v. Nat. Res. Def. Council, 467 U.S. 837, 842 (1984).
[48] *Id.*
[49] *Id.*

attempts to broaden the reach of the CWA (or any environmental law) will be met with heightened scrutiny and are more likely to fail.

As described above, long-standing Supreme Court precedent controls judicial interpretation of the extent of statutorily-granted agency authorities. The seminal case in this doctrine is *Chevron v. NRDC*, where the Court first established the principle that courts should defer to reasonable agency interpretations of ambiguous statutes.[50] As we describe below, there is a real possibility that the *Chevron* doctrine may soon be curtailed or even overruled,[51] but as of the writing of this article it is still valid precedent and is used with regularity by lower courts.[52] It therefore deserves consideration when determining whether courts would uphold agency inclusion of carbon storage into CWA Section 404 compensatory mitigation standards.

The initial question posed by *Chevron* is whether congressional intent on agency interpretation of its authority is clear.[53] In other words, did Congress clearly mean to provide the agency with the particular authority at issue when it adopted the guiding statute?

The CWA does not include mention of climate change or carbon, but Congress' failure to name a particular environmental phenomenon or impact in a statute does not necessarily mean that it did not intend to provide authority to address it. Indeed, in *Massachusetts v. EPA* the Supreme Court found clear authority in the Clean Air Act (CAA) for EPA to regulate greenhouse gas emissions from motor vehicles even though the CAA does not reference such pollutants or climate change and, when drafting the law, Congress "might not have appreciated the possibility that burning fossil fuels could lead to global warming."[54] In that case, the Court noted that the Congress that drafted the CAA showed, through its broad language defining pollutants that EPA must regulate in

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[50] *Id.*
[51] *See* Kristin Hickman & Aaron Nielson, *The Future of Chevron Deference*, 70 DUKE L. J. 1015 (2021).
[52] *See* Kent Barnett & Christopher Walker, Chevron *in the Circuit Courts*, 116 MICH. L.R. 1 (2017).
[53] *Chevron*, 467 U.S. at 842 (1984).
[54] Mass. v. Env't Prot. Agency, 549 U.S. 497, 532 (2007).

new motor vehicles, that it did "understand that without regulatory flexibility, changing circumstances and scientific developments would soon render the [CAA] obsolete."[55] It quoted another of its decisions, *Pennsylvania Dept. of Corrections v. Yeskey*,[56] where the Court noted that "the fact that a statute can be applied in situations not expressly anticipated by Congress does not demonstrate ambiguity. It demonstrates breadth."[57]

Like the CAA, the CWA does not mention greenhouse gases or climate change. But do the CWA's provisions clearly indicate congressional intent to create flexibility and breadth supporting the inclusion of carbon storage in Section 404 compensatory mitigation standards? Historical accounts of the CWA's development show that a diverse set of interest groups were involved in its creation, and indicate that it was intended to be a comprehensive, broadly applicable law.[58] Indeed, until recently the CWA has been broadly interpreted to authorize a variety of agency programs and policies that support the Act's "guiding star"[59] – "the intent of Congress to improve and preserve the quality of the Nation's waters."[60] The CWA has even been interpreted to apply to discharges to groundwater in certain situations,[61] and the mitigation program itself is an agency-created program that relies on the broad authorities provided by the Act.[62]

Despite the CWA's historically broad interpretation, a reading of its provisions suggests that, when considering carbon storage impacts from Section 404 permits, courts may not find clear statutory authority as in *Massachusetts v. EPA.* Unlike the CAA, the CWA narrowly defines pollutants to include an exclusive list of substances,[63] and only covers the introduction of pollutants from

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[55] *Id.*
[56] Pa. Dept. of Corr. v. Yeskey, 524 U.S. 206, 212 (1998).
[57] *Mass. v. Env't Prot. Agency,* 549 U.S. at 532 (quoting *Pa. Dept. of Corr.*, 524 U.S. at 212).
[58] *See* PAUL MILAZZO, UNLIKELY ENVIRONMENTALISTS: CONGRESS AND CLEAN WATER, 1945-1972 (2006).
[59] American Petroleum Institute v. EPA, 540 F.2d 1023, 1028 (1976).
[60] *Id.*
[61] Cnty. of Maui v. Haw. Wildlife Fund, 590 U.S. __, 140 S.Ct. 1462 (2020).
[62] The CWA does not include the term "mitigation."
[63] 33 U.S.C. § 1362(6).

point sources[64] into surface waters.[65] As carbon storage is long-term avoidance of emissions into the atmosphere, we have a mismatch between the medium into which the pollutant is emitted (air or the atmosphere) and where the impacts occur (water).[66] Scholars have described the difficulties this mismatch poses for utilizing the CWA to contend with ocean acidification caused by climate change, noting that CWA permit programs are not applied to other airborne pollutants that clearly impact water quality, such as mercury.[67] Incorporation of carbon storage into CWA Section 404 compensatory mitigation standards could be interpreted as another medium mismatch for which no statutory authority exists.

Adding to this mismatch issue is the fact that regulators have themselves narrowed the applicable medium for CWA Section 404 mitigation. The 2008 Rule mandates that mitigation occurs according to a "watershed approach," where, to the greatest extent practicable, mitigation should occur in the same watershed as

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[64] The CWA defines a point source as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture." 33 U.S.C. § 1362(14).

[65] 33 U.S.C. § 1344(a) (the Corps "may issue permits … for the discharge of dredge or fill material into the navigable waters at specified disposal sites"); 33 U.S.C. § 1362(12) (defining "discharge of a pollutant" and "discharge of pollutants" as "(A) any addition of any pollutant to navigable waters from any point source, (B) any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or floating craft").

[66] *See* Robin Kundis Craig, *Dealing with Ocean Acidification: The Problem, the Clean Water Act, and State and Regional Approaches*, 6 WASH. J. ENVTL. L. & POL'Y 387, 408 (2016) (describing the challenge with U.S. environmental law's tendency to regulate pollution based on the "medium into which a source emits," including the CWA's application to only pollutants that are discharged into the water).

[67] *Id.* at 414 (stressing that pollutants in air do not trigger CWA permit programs, stating that "even if an ocean acidification hot spot like Puget Sound were surrounded by coal-fired power plants emitting thousands of tons of carbon dioxide into the atmosphere every year, and even if it could be proven that those emissions were exacerbating ocean acidification within the Sound itself, the power plants would not need CWA regulatory … permits").

the permitted impacts.[68] This requirement is based on the scientific reality that watersheds are interconnected aquatic systems where impacts at one location in a watershed can positively or negatively influence aquatic functions in another location in that watershed. Under Section 404, the agencies have indicated concerns not only with pollutant discharges to waters in general, but pollutant discharges to a particular watershed. Including carbon storage in Section 404 compensatory mitigation standards, on the other hand, would require permittees to compensate for pollutant discharges into the air that indirectly impact water quality globally, not at a watershed scale.

Even if a court found that the CWA was ambiguous concerning the authority to include carbon storage in Section 404 compensatory mitigation standards, it seems unlikely that EPA and/or the Corps' decision to so interpret that it did would be deemed "reasonable." As described above, the agencies themselves have already focused the compensatory mitigation program on watershed-scale impacts. Furthermore, as described in Section IV.B below, the implementation of such a requirement may not meet the practicability standards imposed by the 2008 Rule.

Recent decisions also suggest that, generally speaking, the current Supreme Court will be more skeptical when agencies expand the scope of programs and policies under environmental statutes. In *West Virginia v. EPA,* the Court struck down the Obama Administration's Clean Power Plan because it found the plan's method of viewing emissions reductions at the grid rather than the individual facility level was not authorized by Congress under the CAA.[69] In doing so, the Court relied on the newly-enunciated "major questions doctrine," under which "clear congressional authorization" must exist for agency exercises

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[68] 33 C.F.R. § 332.3(c) ("The district engineer must use a watershed approach to establish compensatory mitigation requirements in [CWA Section 404] permits to the extent appropriate and practicable… The ultimate goal of a watershed approach is to maintain and improve the quality and quantity of aquatic resources within watersheds through strategic selection of compensatory mitigation sites."); 33 C.F.R. § 332.2 (defining "watershed approach" as "an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed … [that] involves consideration of watershed needs, and how locations and types of compensatory mitigation practices address those needs").

[69] W. Va. v. Env't Prot. Agency, 597 U.S. 697 (2022).

of authority that are broader than those historically asserted and possess "economic and political significance."[70] Although it seems unlikely that a court would view the inclusion of carbon storage into Section 404 compensatory mitigation standards as a "major question," this case has been viewed by some as evidence of the current Supreme Court's heightened scrutiny of broadening of agency authorities under environmental statutes in general.[71]

More pointedly, the Supreme Court recently limited the scope of the CWA, with particular implications for the Section 404 program. In *Sackett v. EPA,*[72] the Court held that the Act's definition of "waters of the United States," for purposes of determining coverage of a water body under the act, was limited to "only those relatively permanent, standing or continuously flowing bodies of water forming geographic[al] features that are described in ordinary parlance as streams, oceans, rivers, and lakes,"[73] and wetlands that are "indistinguishably part of a body of water that itself constitutes 'waters' under the CWA."[74] This decision, the most recent in a series of cases concerning the scope of CWA coverage,[75] limits the instances in which a Section 404 permit will be required, although it appears to maintain CWA coverage over tidally-influenced waters.[76] Even before *Sackett*, commentators emphasized the Court's shift in CWA interpretation from a focus on legislative history and the Act's purpose to one rooted in textualism and state's rights.[77] Post-*Sackett*, it would appear that the Court may be even less likely to uphold an expansion of CWA agency authority without clear textual support in the Act.

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[70] *Id.* at 700.
[71] *See* Michael Burger & Cynthia Hanawalt, *The Major Questions Doctrine is a Fundamental Threat to Environmental Protection. Should Congress Respond?*, COLUM. L. SCH., SABIN CTR. FOR CLIMATE CHANGE L.: CLIMATE L. BLOG (Oct. 19, 2023).
[72] Sackett v. Env't Prot. Agency, 598 U.S. 651 (2023).
[73] *Id.* at 671.
[74] *Id.* at 676.
[75] United States. v. Riverside Bayview Homes, Inc., 474 U.S. 121 (1985); Solid Waste Agency of Northern Cook Cnty. v. U.S. Army Corps of Eng'rs, 531 U.S. 159 (2001); Rapanos v. United States, 547 U.S. 715 (2006).
[76] *Sackett*, 598 U.S. at 678.
[77] *See* Stephen Johnson, *From Protecting Water Quality to Protecting States' Rights: Fifty Years of Supreme Court Clean Water Act Statutory Interpretation*, 74 SMU L. REV. 359 (2021).

Finally, it is well worth mentioning that the ways courts interpret agency authorities may soon change, limiting or even eliminating judicial deference to agency decision making. As of the writing of this article, the Supreme Court is poised to hear two cases concerning *Chevron* deference,[78] and legal scholars suggest that the Court may curtail, or even overrule, that seminal decision.[79] Depending on the Court's ruling, agencies may find it even more challenging to respond to emerging issues under existing environmental laws.

B. Practicability

A second challenge for incorporating carbon storage into CWA Section 404 mitigation standards stems from the rule governing compensatory mitigation. This challenge is practicability. Although practicability may only be a challenge for a subset of carbon accounting methodologies, it does bear mentioning here.

Practicability is a "fundamental underpinning" of the 2008 mitigation rule.[80] The term "practicable," which appears in the rule 36 times,[81] is defined as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."[82] Practicability considerations can impact Section 404 mitigation in many ways. The 2008 Rule states that compensatory mitigation required for a Section 404 permit must be based not only on the "aquatic resource functions that will be lost," but also on "what is practicable."[83] Practicability is also an element of compensatory

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[78] The Court will consider *Loper Bright Enterprises v. Raimondo* and *Relentless, Inc., v. Department of Commerce* in tandem, only addressing the question of whether *Chevron v. NRDC* should be overruled. 601 U.S. 22-1219 (Oct. 13, 2023) (order granting certiorari).
[79] *See* Ethan Leib & Nora Donnelly, *Statutory Interpretation in the 2020s: A View of the Cathedral*, 97 S. CAL. L. REV. Postscript 11, 20 (2024) (noting the repeated dismissal of the *Chevron* doctrine by the Supreme Court and stating that this shows the doctrine's "looming death); Hickman & Nielson, *supra* note 51.
[80] Royal Gardner et al., *Compensating for Wetland Losses Under the Clean Water Act (Redux): Evaluating the Federal Compensatory Mitigation Regulation*, 38 STETSON L. REV. 213 (2009).
[81] 33 C.F.R. § 332; 40 C.F.R. §§ 230.91-98.
[82] 33 C.F.R. § 332.1(c)(2); 40 C.F.R. § 230.91(c)(2).
[83] 33 C.F.R. § 332.3(a)(1); 40 C.F.R. § 230.93(a)(1).

mitigation site selection,[84] amount of mitigation,[85] mitigation timing,[86] ecological performance standards,[87] site management,[88] and standards for particular types of mitigation programs.[89] For our purposes, the 2008 Rule's practicability considerations for ecological performance standards warrant further attention.

Mitigation plans for Section 404 permits "must contain performance standards that will be used to assess whether the project is achieving its objectives."[90] These standards should allow for an objective evaluation of the project,[91] and, importantly, "must be based on the best available science that can be measured or assessed in a practicable manner."[92] Across Corps districts, the practicability qualifier for ecological performance standards has largely been incorporated through the use of rapid assessment methods – notably, the Hydrogeomorphic Approach for Assessing Wetland Functions (HGM Approach).[93] Notably, the HGM Approach uses regional reference sites to compare wetland functions at Section 404 project and mitigation sites, and is designed to "maintain compatibility with the time and resource framework of [Section 404]"[94] by "being timely, accurate and cost-effective."[95]

Practicability could be a barrier to the incorporation of some carbon storage analysis methodologies into Section 404 compensatory mitigation

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[84] 33 C.F.R. § 332.3(d); 40 C.F.R. § 230.93(d).
[85] 33 C.F.R. § 332.3(f)(1); 40 C.F.R. § 230.93(f)(1).
[86] 33 C.F.R. § 332.3(m); 40 C.F.R. § 230.93(m).
[87] 33 C.F.R. § 332.5(b); 40 C.F.R. § 230.95(b).
[88] 33 C.F.R. § 332.7; 40 C.F.R. § 230.97.
[89] 33 C.F.R. § 332.8; 40 C.F.R. § 230.98 (practicability standard applies to mitigation banking and in-lieu fee programs).
[90] 33 C.F.R. § 332.5(a); 40 C.F.R. § 230.95(a).
[91] 33 C.F.R. § 332.5(a); 40 C.F.R. § 230.95(a).
[92] 33 C.F.R. § 332.5(b); 40 C.F.R. § 230.95(b).
[93] The National Action Plan To Implement the Hydrogeomorphic Approach To Assessing Wetland Functions**,** 62 Fed. Reg. 33607 (June 20, 1997) [hereinafter HGM Approach]; *see also* Hydrogeomorphic Approach, U.S. ARMY CORPS OF ENG'RS (Jan. 18, 2013).
[94] HGM Approach, *supra* note 93, at 33610.
[95] *Id.* at 33611. Commentators have noted the impact of practicability considerations for mitigation ecological performance standards, explaining that "one should distinguish between a research project that is intended to dissect wetland functions at a fine-grained level and performance measures that assess functions at a coarsely grained level," and noting that the former is likely not practicable. Gardner et al, *supra* note 80, at note 115.

standards. The most comprehensive analyses, such as those required for carbon offsetting projects,[96] are complex and data-heavy endeavors. Requiring this type of costly study for Section 404 compensatory mitigation would likely fail to meet the practicability standard. These intensive analyses are, however, utilized to assess how much carbon an individual system can store for the purpose of mitigating global climate change; this purpose would potentially disqualify the use of these analyses due to separation of powers issues even in absence of any practicability standard.

As described in Section V below, there may be other ways of incorporating some level of carbon-related function into CWA Section 404 compensatory mitigation standards that, while falling short of a full carbon storage accounting, can provide reasonable and regionally appropriate estimates. As we will now describe, however, it would be incumbent upon individual Corps districts to develop and implement such methodologies.

C. The Decentralized Nature of the Corps

As if issues of constitutional legitimacy and regulatory practicability weren't enough, there exists a third challenge to the incorporation of carbon storage into Section 404 mitigation standards. Though it may be a small consolation, this barrier does only pertain to the ability to incorporate carbon storage into mitigation standards at a *nationwide* scale.

The Army Corps regulatory program is "highly decentralized,"[97] with most permitting authority, including that for CWA Section 404, delegated to 39 domestic district engineers and 9 division engineers.[98] Although all Corps districts and divisions operate under the same general regulatory principles in the implementation of their Section 404 responsibilities, district engineers maintain significant discretion in program development and permit issuance decision

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[96] *See* VERRA, *supra* note 35. *See also* S. SETTELMYER, E. SWAILS & J. EATON, TERRACARBON, HERRING RIVER CARBON PROJECT FEASIBILITY STUDY V.1.7 (2019).
[97] 33 C.F.R. § 320.1(a)(2).
[98] The current regulation appears to use old district and division totals. *Id.* For a current accounting, *see* *Where We Are*, U.S. ARMY CORPS OF ENG'RS (last visited Feb. 26, 2024).

making. Indeed, the "autonomous culture" of Corps districts has been cited in government reports as an impediment to organizational realignment efforts and project cooperation.[99] Corps district discretion is incorporated throughout the 2008 Rule.

The 2008 Rule provides general parameters for mitigation under Section 404 permits.[100] District engineers must "determine the compensatory mitigation to be required in a [Section 404] permit, based on what is practicable and capable of compensating the aquatic resource functions that will be lost as a result of the permitted activity."[101] Importantly, district engineers have discretion in the methods used to determine loss and gain of aquatic resource functions, including the parameters they may measure.

The 2008 rule states that the amount of compensatory mitigation for Section 404 permits "must be, to the extent practicable, sufficient to replace lost aquatic resource functions."[102] The rule establishes a preference for "functional or condition assessment methods" over ratio methods (i.e., those that require at least a one-to-one acreage or linear foot compensation), but only "when practicable."[103] Although the 2008 rule defines the terms "functions" ("the physical, chemical, and biological processes that occur in ecosystems"[104]) and "condition" ("the relative ability of an aquatic resource to support and maintain a community of organisms having a species composition, diversity, and functional organization comparable to reference aquatic resources in the region"[105]), it does not identify specific functional or conditional attributes that must be included in "functional or condition assessment methods." And while EPA and the Corps have endorsed methods such as the HGM Approach, they are by no means required.

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[99] U.S. GOV'T ACCOUNTABILITY OFF., ARMY CORPS OF ENGINEERS: ORGANIZATIONAL REALIGNMENT COULD ENHANCE EFFECTIVENESS, BUT SEVERAL CHALLENGES WOULD HAVE TO BE OVERCOME 21 (2010).
[100] 33 C.F.R. 332. *See also* Hough & Harrington, *supra* note 14.
[101] 33 C.F.R. § 332.3(a)(1); 40 C.F.R. § 230.93(a)(1).
[102] 33 C.F.R. § 332.3(f)(1); 40 C.F.R. § 230.93(f)(1).
[103] 33 C.F.R. § 332.3(f)(1); 40 C.F.R. § 230.93(f)(1).
[104] 33 C.F.R. § 332.2; 40 C.F.R. § 230.92.
[105] 33 C.F.R. § 332.2; 40 C.F.R. § 230.92.

More detail is provided in the 2008 Rule concerning the selection of mitigation sites and evaluation of mitigation plans, but district engineers are still provided with discretion in how they fashion their individual programs. The 2008 Rule lists factors that the district engineer must consider when assessing the "ecological suitability" of mitigation sites.[106] These factors include "soil characteristics… and other physical and chemical characteristics," but do not specifically identify any particular parameters.[107] Likewise, in its consideration of "ecological performance standards" that are used to determine whether the mitigation project is achieving its objectives, the 2008 Rule does not specifically identify any particular performance standard that must be part of a district's Section 404 program.[108] Rather, it states that these standards "may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position."[109] In practice, mitigation standards and approaches vary across Corps districts based on local conditions and preferences.[110]

It appears unlikely that Section 404 rules would be amended to either require inclusion of one specific parameter – carbon storage – in national

[106] 33 C.F.R. § 332.3(d)(1); 40 C.F.R. § 230.93(d)(1).
[107] 33 C.F.R. § 332.3(d)(1)(i); 40 C.F.R. § 230.93(d)(1)(i).
[108] 33 C.F.R. § 332.5; 40 C.F.R. § 230.95.
[109] 33 C.F.R. § 332.5(b); 33 C.F.R. § 230.95(b). A lack of comparable reference sites can impact the performance standards selected for mitigation sites. *See* MAPACHE, LLC, *supra* note 26 ("Both the Bank Sponsor and the IRT recognize that calibrating performance standards is an imperfect science at this point in time. Statistically valid sets of reference data for the types of habitats being targeted by mitigation sites are not known to comprehensively exist for the State of Georgia. Additionally, it is not practicable for a project sponsor to collect this amount of information on a project by project basis. Therefore, the Bank Sponsor and IRT have worked together to jointly select the best available reference sites and have used best-professional-judgement in order to set performance standards that are believed to be specific, measurable, attainable, realistic, and timely.").
[110] *See* INST. FOR WATER RES., THE MITIGATION RULE RETROSPECTIVE: A REVIEW OF THE 2008 REGULATIONS GOVERNING COMPENSATORY MITIGATION FOR LOSS OF AQUATIC RESOURCES 98 (2015) (showing the large range of mitigation documents for each Corps district).

mitigation standards or standardized mitigation requirements nationwide,[111] which would be contrary to the historically autonomous and decentralized nature of the Corps. If carbon storage or any other measure of carbon is going to make it into Section 404 mitigation standards, it will probably be at the district or division level.

V. OTHER METHODS FOR INCORPORATING CARBON INTO SECTION 404 COMPENSATORY MITIGATION: NEPA, STORAGE PROXIES, AND RATIOS

Although incorporating carbon storage into CWA Section 404 mitigation standards may not be feasible, other options exist that could, in some fashion, help ensure that Section 404-permitted impacts compensate for the loss of carbon storage in coastal wetlands. Here, we consider three methods: National Environmental Policy Act (NEPA) permit conditions, proxies for storage, in-kind mitigation, and mitigation ratios.

A. Permit conditions via NEPA

Although separation of powers principles may prevent inclusion of carbon storage into CWA Section 404 mitigation standards, it may be possible to incorporate it via individual permit decisions. The most likely method would be through NEPA.[112]

NEPA is a procedural statute that requires federal agencies to evaluate the environmental impacts of proposed agency actions, including issuance of permits.[113] Often called the "hard look" law, NEPA's central requirement is that

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[111] It should be noted that, as recently as 2019, there was consideration of amending the 2008 rule, though these amendments did not appear to include national standardization of mitigation assessment frameworks. *See* *EPA & Army Corps requests comments on potential changes to compensatory mitigation regulations*, NAT'L ASS'N OF COUNTIES (June 15, 2019).

[112] 42 U.S.C. § 4331 – 4370m. Some commentators have argued that NEPA and other environmental impact assessment laws "provide an important … opportunity for immediate global action on climate change." Caleb W. Christopher, *Success by a Thousand Cuts: The Use of Environmental Impact Assessment in Addressing Climate Change*, 9 VT. J. ENV'T L. 549, 552 (2008).

[113] Sabine River Auth. v. U.S. Dep't of Interior, 951 F.2d 669, 676 (5th Cir. 1992).

agencies prepare a comprehensive (and often expensive) environmental impact statement (EIS) "for any major federal action significantly affecting the quality of the human environment."[114] Agencies often first prepare an Environmental Assessment (EA) to determine whether an EIS is necessary.[115] If the EA leads the agency to determine that the proposed action would result in "significant"[116] environmental impacts, an EIS is required.[117] If the EA shows that the proposed action would not result in significant environmental impacts, the agency issues a Finding of No Significant Impact (FONSI)[118] and has no further obligations under NEPA.

In reality, it is rarely the federal agency that foots the bill for preparation of an EA or EIS. In the case of federal permits, including those issued under Section 404, the permit applicant is responsible for funding the NEPA analysis. Because the preparation of an EIS is a lengthy and expensive endeavor, permit applicants may be willing to agree to less expensive permit conditions that would result in a FONSI. Indeed, courts and the Council for Environmental Quality (CEQ), which administers NEPA, have sanctioned the use of what some call a "mitigated FONSI,"[119] where a project's impacts are "reduced to a less-than-significant level via mitigation conditions attached to the permit."[120]

In January of 2023, the CEQ released the interim "[NEPA] Guidance on Consideration of Greenhouse Gas Emissions and Climate Change" (CEQ GHG Guidance).[121] It states that agencies "should quantify the reasonably foreseeable direct and indirect [greenhouse gas] emissions of their proposed actions and reasonable alternatives,"[122] and notes that "NEPA requires more than a statement

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[114] 42 U.S.C. § 4332(2).
[115] 40 C.F.R. § 1508.9.
[116] *See* 40 C.F.R. § 1508.27 (defining the term "significantly").
[117] 42 U.S.C. § 4332.
[118] 40 C.F.R. § 1508.13.
[119] Matthew D. Ross, *Fresh Down the Pipeline: An Analysis of the Fifth Circuit's Decision in Atchafalaya Basinkeeper v. United States Army Corps of Engineers*, 93 TUL. L. REV. 1057, 1064 (2019).
[120] O'Reilly v. U.S. Army Corps of Eng'rs, 477 F.3d 225, 229 (5th Cir. 2007).
[121] National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change, 88 Fed. Reg. 1196 (Jan. 9, 2023) [hereinafter NEPA GHG Guidance].
[122] *Id.* at 1201.

that emissions from a proposed Federal action or its alternatives represent only a small fraction of global or domestic emissions"[123] because "this approach does not reveal anything beyond the nature of the climate change challenge itself."[124] The guidance encourages agencies "to mitigate GHG emissions associated with their proposed actions to the greatest extent possible."[125] It makes clear that difficulties in quantifying GHG emissions are not viewed as insurmountable, and agencies "should seek to present a reasonable estimated range of quantitative emissions for the proposed action and alternatives."[126] It also advises agencies that the "rule of reason" that is "inherent in NEPA and the CEQ regulations"[127] and the "concept of proportionality" should guide their determinations on how to consider environmental impacts and prepare NEPA analyses.[128]

The CEQ GHG Guidance provides specific detail concerning "biogenic" emissions that result from land management practices, including changes to biological GHG sources and sinks from wetlands management.[129] For biogenic emissions, the Guidance states that:

> agencies should include a comparison of net GHG emissions and carbon stock changes that are anticipated to occur, with and without implementation of the proposed action and reasonable alternatives. The analysis should consider the estimated GHG emissions…, carbon sequestration potential, and the net change in relevant carbon stocks in light of the proposed actions and timeframes under consideration, and explain the basis for the analysis.[130]

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123 *Id.*
124 *Id.*
125 *Id.* at 1197.
126 *Id.* at 1202.
127 *Id.* at 1198.
128 *Id.* at 1202.
129 *Id.* at 1207.
130 *Id.*

Recognizing that "[i]dentifying and analyzing potential mitigation measures is an important component of the NEPA process,"[131] including in how agencies "assess the potential climate change effects of proposed actions and reasonable alternatives,"[132] the CEQ GHG Guidance "encourages agencies to mitigate GHG emissions to the greatest extent possible."[133] It includes carbon sequestration and land management practices as examples of potential mitigation measures.[134]

NEPA and the CEQ GHG Guidance could offer a mechanism for introducing carbon storage considerations into Section 404 permit conditions.[135] Permittees seeking to avoid an expensive and time-consuming EIS[136] could agree to permit conditions requiring compensatory mitigation that would be sufficient to offset estimated biogenic emissions from impacts to coastal wetlands. In practice, this type of mitigated FONSI could be accomplished via mitigation ratios – precisely what commentators suggested could occur through inclusion of carbon storage in mitigation standards. Ratios could be used to account for the uncertainty in carbon storage lost at an impact site and gained via compensatory mitigation, and in-kind mitigation could be required to account for the risk of other wetland types actually acting as a source of GHGs.[137]

Interestingly, there could be potential for the CEQ GHG Guidance to support emerging blue carbon markets. The Guidance notes that agencies should utilize mitigation that meets "appropriate performance standards" to ensure it is "verifiable, durable, enforceable, and will be implemented."[138] Mitigation banks authorized under Section 404 regulations would qualify here, and verified blue carbon projects may as well. If the CEQ GHG Guidance results in more coastal

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[131] *Id.* at 1206.
[132] *Id.*
[133] *Id.*
[134] *Id.*
[135] To be fair, this mechanism already existed under NEPA, but CEQ has made it a mandate.
[136] The CEQ GHG Guidance specifically notes that "mitigation can be particularly effective in helping agencies reduce or avoid significant effects." NEPA GHG Guidance, 88 Fed. Reg. at 1206.
[137] *But see* Michael J. Osland et al., *Migration and transformation of coastal wetlands in response to rising seas*, 8 SCI. ADVANCES eabo5174, 2 (2022) (showing the potential for saline coastal wetlands to migrate landward as seas rise and the threats to freshwater wetlands (and the services they provide) this may represent).
[138] NEPA GHG Guidance, 88 Fed. Reg. at 1206.

wetland mitigation being included in Section 404 permits, it could bolster the development of domestic blue carbon projects and markets.

B. Proxies

As described above, comprehensive carbon storage analyses for coastal wetlands are complex endeavors that are unlikely to be included in compensatory mitigation standards because of separation of powers concerns and practicability issues. There are, however, simpler measurements and methods that, while not accounting for the full carbon storage potential of a blue carbon system, do provide useful information about stocks that could be a general proxy for carbon storage. If these measurements were both directly related to water quality and/or aquatic function and were relatively low effort and cost, they could survive the separation of powers and practicability challenges described above. Two potential proxies may deserve attention here: soil carbon content and vertical accretion.

i. Soil Carbon Content

Most of the carbon stored by coastal blue carbon systems is in the soil,[139] and soil carbon can be a measure of aquatic resource function. Soil organic carbon is sometimes referred to as the "glue and sponge" of soils for its ability to stick together soil aggregates,[140] retain water,[141] and provide habitat and energy to soil microorganisms.[142] These physical and biogeochemical services can result in increased water infiltration and nutrient removal,[143] both of which are key components of aquatic resource function. Although measuring soil carbon stocks does not tell you whether the carbon is actually stored long-term,[144] it is a

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[139] Ken Krauss, The Blue Carbon Resource: Budget and Vulnerabilities, Presentation at the 2023 Blue Carbon Law Symposium, Athens, GA, May 18, 2023.

[140] D.C. Reicosky, *Conservation Agriculture: Global Environmental Benefits of Soil Carbon Management*, *in* CONSERVATION AGRICULTURE 3, 4 (L. Garcia-Torres et al., eds., 2003).

[141] *See* Dianna Bagnall et al., *Carbon-sensitive pedo-transfer functions for plant available water*, 86 SOIL SCI. SOC'Y OF AMERICA J. 612 (2022).

[142] Reicosky, *supra* note 140, at 4.

[143] *See* *Grounded in Soil: Water Quality Benefits from Healthy Soils*, PENN STATE EXTENSION (May 11, 2020).

[144] *See* Gabriel Popkin, *A Soil-Science Revolution Upends Plans to Fight Climate Change*, QUANTA MAG. (July 27, 2021).

relatively simple process and can be a useful stand-in.[145] Studies have examined soil carbon stocks in tidal wetlands across the conterminous U.S.,[146] and a global consortium of researchers and land managers has compiled a Coastal Carbon Data Library and a Coastal Carbon Atlas that could be used to identify regional reference sites for soil carbon stocks.[147]

Soil carbon typically takes longer to establish than frequently utilized indicators of aquatic function at Section 404 impact and mitigation sites. Other commonly used indicators respond very quickly following a restoration or other management action. Plant species composition and biomass, for example, can often reach levels of a natural site within 2-5 years (excluding trees). Soil carbon, on the other hand, may take much longer to restore.[148] Higher mitigation ratios, based on temporal loss, could be appropriate here and help ensure that the carbon storage balance of the permitted impact would tend towards a carbon sink rather than a source.

Research on soil carbon content's impacts on water quality and aquatic function does, however, appear to be limited in scope and generally applied to agricultural contexts. This could make it an awkward fit for compensatory mitigation standards. In addition, selection of representative reference sites for comparison would be required to ensure target soil carbon content was reasonable. This may be challenging given the dynamic nature of coastal systems.

ii. Vertical accretion

Vertical accretion essentially refers to a coastal blue carbon system "building up" over time.[149] Historic diking and drainage of coastal marshes and

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[145] *See* James R. Holmquist et al., *Accuracy and Precision of Tidal Wetland Soil Carbon Mapping in the Conterminous United States*, 8 SCI. REP. 9478 (2018); Spivak et al., *supra* note 34, at 685-692.
[146] Holmquist et al., *supra* note 145.
[147] *Coastal Carbon Research Network*, SMITHSONIAN ENV'T RSCH. CTR. (last visited Feb. 26, 2024).
[148] Pendleton et al., *supra* note 37, at 445.
[149] Judith Drexler et al., *Carbon accumulation and vertical accretion in a restored versus historic salt marsh in southern Puget Sound, Washington, United States*, 27 RESTORATION ECOLOGY 1117 (2019).

other coastal blue carbon systems – once common practices for flood control, infrastructure management, waterfowl benefits, and agricultural conversion[150] – separated them from tidal action and made them vulnerable to various forms of degradation that limit accretion and other processes.[151] Coastal wetland restoration projects, including those utilized as Section 404 mitigation sites, often involve techniques designed to restore tidal inundation, which should result in an increase in vertical accretion.[152] Other restoration techniques, such as sediment stabilization via revegetation, can also increase vertical accretion.[153]

Accretion can be indicative of healthy coastal wetland systems and is a key element in determining their vulnerability to submergence from sea level rise.[154] It can also show how these systems are *responding* to sea level rise: higher water levels can actually cause coastal wetland vegetation to increase biomass higher in the water column, which can trap sediment and cause other processes

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[150] *Id.*

[151] *Id.*; Christopher Craft et al., *Twenty-five years of ecosystem development of constructed spartina alterniflora (loisel) marshes*, 9 ECOLOGICAL APPLICATIONS 1405 (1999); D. Burdick et al., *Ecological responses to tidal restorations of two northern New England salt marshes*, 4 WETLANDS & ECOLOGY MGMT. 129 (1996); Christopher Craft et al., *Fifteen Years of Vegetation and Soil Development after Brackish-Water Marsh Creation*, 10 RESTORATION ECOLOGY 248 (2002); Megan Eagle et al., *Soil carbon consequences of historic hydrologic impairment and recent restoration in coastal wetlands*, 848 SCI. TOTAL ENV'T 157682 (2002).

[152] Drexler et al., *supra* note 149; Craft et al., *Twenty-five years of ecosystem development of constructed spartina alterniflora (loisel) marshes, supra* note 151; Burdick et al., *supra* note 151; Craft et al., *Fifteen Years of Vegetation and Soil Development after Brackish-Water Marsh Creation, supra* note 151; Eagle et al., *supra* note 151.

[153] Drexler et al., *supra* note 149; Craft et al., *Twenty-five years of ecosystem development of constructed spartina alterniflora (loisel) marshes, supra* note 151; Burdick et al., *supra* note 151; Craft et al., *Fifteen Years of Vegetation and Soil Development after Brackish-Water Marsh Creation, supra* note 151; Eagle et al., *supra* note 151; G. Curado et al., *Vertical sediment dynamics in* Spartina maritima *restored, non-restored and preserved marshes*, 47 ECOLOGICAL ENG'G 30 (2012).

[154] Simon M. Mudd et al., *Impact of dynamic feedbacks between sedimentation, sea-level rise, and biomass production on near-surface marsh stratigraphy and carbon accumulation*, 82 ESTUARINE, COASTAL, & SHELF SCI. 377 (2009); Torbjörn E. Törnqvist et al., *Coastal Wetland Resilience, Accelerated Sea-Level Rise, and the Importance of Timescale*, 2 AGU ADVANCES e2020AV000334 (2021); KATHLEEN GOODIN ET AL., NATURESERVE, ECOLOGICAL RESILIENCE INDICATORS FOR FIVE NORTHERN GULF OF MEXICO ECOSYSTEMS 56 (2018).

that will increase accretion and "build up" the wetland system.[155] As such, it may be a legally defensible measure of aquatic function appropriate for inclusion in Section 404 standards. Additionally, accretion can also be a proxy for soil carbon accumulation in restored coastal wetlands; studies indicate that as restored coastal wetlands vertically accrete they also accumulate soil carbon.[156] Research also suggests that carbon accumulation rates are highest at young and expanding marsh edges.[157]

Accepted methods for measuring vertical accretion could meet the practicability requirements of the 2008 Rule. Short-term deposition can be measured using white feldspar clay as a marker horizon – essentially, something placed on top of the marsh sediment that acts as a point of reference when later measuring soil cores.[158] Such methods are rather inexpensive,[159] and while short-term deposition is not a suitable proxy for soil carbon it can be indicative of the restoration of aquatic function. The "gold standard" for measuring longer-term accretion, using radioisotopes to create geochronological models,[160] may also fall within the parameters of practicability depending on overall project costs. Depending on the number of samples analyzed, total costs could range somewhere between a few hundred to a few thousand dollars. A lack of reference sites could be a challenge with measurement of vertical accretion, but tools such as the Coastal Carbon Data Library and Coastal Carbon Atlas could potentially be used to find regionally appropriate values.

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[155] *See* News Release, National Science Foundation, Wetlands' ability to overcome sea level rise threatened (Dec. 4, 2013).
[156] Drexler et al., *supra* note 149.
[157] Miller et al., *supra* note 32.
[158] *See* Marker Horizons, TIDAL MARSH MONITORING (last visited Feb. 26, 2024).
[159] For a ~100-acre site, feldspar deposition monitoring could cost in the hundreds of dollars for equipment and measurements, personnel costs excluded. Email communication with Amanda Spivak, Associate Professor, Univ. of Ga. Dep't of Marine Sci. (June 29, 2023) (on file with author).
[160] James T. Morris & William B. Bowden, *A Mechanistic, Numerical Model of Sedimentation, Mineralization, and Decomposition for Marsh Sediments*, 50 SOIL SCI. SOC'Y AM. J. 96 (1986); James T. Morris et al., *Contributions of organic and inorganic matter to sediment volume and accretion in tidal wetlands at steady state*, 4 EARTH'S FUTURE 110 (2016).

Whether or not mitigation ratios would be influenced by accretion measurements would depend on how they were linked to performance standards for the mitigation site. If performance standards focused on the *rate* of accretion – i.e., whether the site was gaining sediment at a speed that indicated it was "on track" to reach reference site levels – standards could be met rather quickly. If, on the other hand, performance standards focused on the *level* of accretion – i.e., a goal for total amount of accretion desired – it could take long enough (in the order of decades) such that higher ratios could be warranted.

C. In-Kind Mitigation with Higher Mitigation Ratios

As noted in Section IV above, some commentators have suggested that an environmental benefit of including carbon storage in Section 404 mitigation standards is that it may justify higher mitigation ratios based on the temporal loss of carbon storage functions. And as noted in Section V.B, proxies for carbon storage could also trigger higher ratios based on temporal loss. These mechanisms all, however, involve varying degrees of additional (and potentially unwelcome) data collection and analysis for Section 404 permittees, mitigation professionals, and regulators. There may, however, be a much simpler mechanism for achieving the same ends.

The 2008 Rule states a preference for in-kind mitigation, where the mitigation project is conducted in "a resource of similar structural and functional type to the impacted resource."[161] When discussing this preference, it uses coastal wetlands as an example, noting that "tidal wetland compensatory mitigation projects are most likely to compensate for unavoidable impacts to tidal wetlands."[162] Although district engineers may use out-of-kind mitigation when it "will serve the aquatic resource needs of the watershed,"[163] the preference for in-kind mitigation and significant discretion afforded to district engineers indicates that a stringent focus on in-kind mitigation for specific resource types could be justifiable.

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[161] 33 C.F.R. § 332.2; 40 C.F.R. § 230.92.
[162] 33 C.F.R. § 332.3(e)(1); 40 C.F.R. § 230.93(e)(1).
[163] 33 C.F.R. § 332.3(e)(2); 40 C.F.R. § 230.93(e)(2).

The 2008 Rule also requires that district engineers use mitigation ratios greater than one-to-one in a number of situations, including where necessary to account for the likelihood of success and the difficulty of restoring the desired aquatic resource type and functions.[164] Importantly, there is no medium limitation on this provision; the likelihood of success and the difficulty in restoring the resource type and functions could be caused by a wide range of factors, including global climate change. As global climate change causes seas to rise, coastal wetlands of all kinds will be vulnerable to its effects. Some coastal blue carbon systems will be inundated, and some will migrate landward, displacing freshwater wetlands and upland land covers.[165] Indeed, these threats suggest that higher mitigation ratios for *all* types of coastal wetland classes, including freshwater wetlands that may not qualify as blue carbon, could be warranted.[166]

If Corps districts required in-kind mitigation and higher mitigation ratios for coastal blue carbon resources, carbon storage functions lost at Section 404 permit sites would be more likely to be replaced by compensatory mitigation. In-kind mitigation could help Corps districts avoid situations in which a coastal blue carbon system is mitigated for with restoration of a different resource type that may be a source of carbon dioxide and other greenhouse gases (for example, when impacts to a coastal marshland are mitigated by restoring a freshwater wetland). Higher mitigation ratios could help account for the variability in carbon storage among blue carbon resource sites; if a mitigation site stored less carbon per acre than an impact site, requiring a higher ratio may still result in no net loss, or even a net gain, in carbon storage function.

VI. CONCLUSION

Incorporation of carbon metrics into Section 404 compensatory mitigation standards appears to be a losing proposition if the purpose is to mitigate global climate change by replacing lost carbon storage functions of blue carbon

[164] 33 C.F.R. § 332.3(f)(2); 40 C.F.R. § 230.93(f)(2).
[165] *See* Osland et al., *supra* note 137, at 2; Nathan McTigue et al., *Sea Level Rise Explains Changing Carbon Accumulation Rates in a Salt Marsh Over the Past Two Millennia*, 124 J. GEOPHYSICAL RSCH.: BIOGEOSCIENCES 2945 (2019).
[166] At the very least, regulators should be paying close attention to the potential of "barriers, opportunities, and trade-offs for wetland landward migration." Osland et al., *supra* note 137, at 5.

resources. Separation of powers principles are the most significant hurdle here, with practicability concerns and the decentralized nature of the Corps also limiting the potential scope of such a proposal. These barriers do not, however, completely preclude any consideration of carbon storage in the context of Section 404 permitting and compensatory mitigation. Other avenues exist that could survive judicial scrutiny, including mitigation pursuant to NEPA, carbon storage proxies that are also elements of aquatic function, and a focus on in-kind mitigation with higher mitigation ratios for coastal wetlands under existing Section 404 regulations. There may be other opportunities beyond those included here. Global climate change is testing the adaptability of existing environmental laws, and interdisciplinary cooperation among lawyers, scientists, and other experts will be required to understand what is legally possible in the U.S. as we contend with a warming world.