UNIVERSITY OF CALIFORNIA
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The U.S. Army Corps of Engineers' Regulatory Program in Ocean and Coastal Waters

A dissertation submitted in partial satisfaction
of the requirements for the degree Doctor of Environmental
Science and Engineering

by

Lia Protopapadakis Flynn

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University of California, Los Angeles, 2023
Professor Richard F. Ambrose, Chair

Abstract: The U.S. Army Corps of Engineers Regulatory Program (Corps) is one of several agencies with overlapping and sometimes conflicting regulatory authority along the coast. The Corps has also become the *de facto* federal regulator of ocean-based activities by virtue of its broad authority to regulate most types of construction activities from the high tide line to the outer continental shelf.

This dissertation seeks to understand 1) whether the Corps is fulfilling its mission of making permit decisions that balance development and natural resource protection in ocean and coastal habitats and 2) how its permits interact with sea level rise adaptation planning in California. First, I describe the Corps' permit data and present methods that can be used by others to acquire and use these data. Next, I used these data to show that the odds of compensatory mitigation was four times less likely when the impact occurred in an ocean/tidal

system, even after controlling for differences that make ocean/tidal impacts less likely to meet the Corps' criteria for requiring compensatory mitigation. Finally, I use a subset of these data to show that the Corps' permits overlap with the California Coastal Commission's Sea Level Rise Policy Guidance in several areas, but the Corps' use of streamlined permits is misaligned with this Guidance in several areas. For example, bank and shoreline armoring work against California's Guidance, but the Corps authorized 98% of bank hardening and 100% of shoreline armoring projects with streamlined permits.

Ocean and coastal habitats are deserving of the same level of protection as freshwater habitats. In the absence of comprehensive ocean management, I propose several steps the Corps can take to improve its protection of ocean and coastal habitats while still allowing development. For example, the Corps could improve the parity of compensatory mitigation rates between ocean/tidal and freshwater impacts by applying existing policy more uniformly to permanent impacts in ocean/tidal, non-special aquatic sites, authorized under Section 404. In addition, the Corps' California Districts could improve its alignment with California's Sea Level Rise Guidance by issuing General Permits for projects encouraged by the Guidance and certified Local Coastal Programs.

The dissertation of Lia Protopapadakis Flynn is approved.

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DEDICATION

To my girls, Makenna and Charlize:

You will never know what you can overcome

until you stare it down and keep right on going.

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ABBREVIATIONS

Abbreviation	Meaning
BCDC	San Francisco Bay Conservation & Development District
CRAN	Comprehensive R Archive Network
CoSMoS	Coastal Storm Modeling System
Corps	U.S. Army Corps of Engineers
EPA	U.S. Environmental Protection Agency
EPSG	European Petroleum Survey Group
ESA	Endangered Species Act
FOIA	Freedom of Information Act Request
GP	General Permit
HUC	Hydrologic Unit Code
LOP	Letter of Permission
NA	Missing value
NAD83	North American Datum of 1983
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service (a.k.a. NOAA Fisheries)

Abbreviation	Meaning
NOAA	National Oceanic and Atmospheric Administration
NWP	Nationwide Permit
ORM2	Operations & Maintenance Business Information Link Regulatory Module 2
RGP	Regional General Permit
RIBITS	Regulatory In-lieu Fee & Bank Info Tracking System
SAS	Special Aquatic Site (40 CFR 230.3(m))
SP	Standard Permit
Section 10	Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)
Section 404	Section 404 of the Clean Water Act of 1972 (33 U.S.C. 1433)
TNC	The Nature Conservancy

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Marine Scientist and Project Manager
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Developed and implemented the Santa Monica Bay Restoration Commission's (SMBRC) plans for scientific research and science-based policy applications. Coordinated the SMBRC's Technical Advisory Committee. Worked with other staff to develop new research and restoration priorities. Use research findings to develop new policies. Communicated findings to the SMBRC Governing Board, stakeholders, elected officials, and the media.

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PUBLICATIONS

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CHAPTER 1: INTRODUCTION

The ocean and coast. Their value is immeasurable. These ecosystems provide us with food, medicine, energy, and peace of mind. Their views and sounds reduce stress, increases cognitive function, and improves one's mood (Browning et al., 2014). An estimated 2.2 million plant and animal species call marine and estuarine waters home (Mora et al., 2011). Corals, mangroves, and other habitats protect our coastlines (Barbier et al., 2011; Narayan et al., 2016). Together they sustain an $11 billion seafood industry and a $131 billion tourism and recreation industry in the United States (National Ocean Economics Program, 2018). But these ecosystems are under threat.

Estuaries and associated coastal wetlands are already among the most altered systems on Earth (Castro & Huber, 2000). Construction of ports and breakwaters, dredging for navigational safety, and filling for commercial or residential developments, have degraded or eliminated approximately 33% of all estuaries in the United States (Castro & Huber, 2000).

Even the ocean, which seems too big to be altered, is now a gauntlet of fishing gear, boat traffic, plastic debris, oil & gas drilling platforms, and sometimes-lethal noise. A few examples: Entanglement is the leading cause of death for large whales (van der Hoop et al., 2013) and the noise from increased shipping and dredging activities have pushed whales out of preferred breeding habitat (Weilgart, 2007), an estimated 4,600 sea turtles die annually as bycatch in the fishing industry and 1,000 more die as a result of entanglement in ghost fishing gear (Duncan et al., 2017), the so-called "Great Pacific Garbage Patch" occupies approximately 1.6 million km^2 of the subtropical Pacific Ocean and contains between 45-129 thousand tons of plastic (Lebreton et al., 2018), and more than 5.8 million tons of oil have been spilled into the ocean in the last 50 years causing harm to marine life and seafood contamination (Zapelini de Melo et al., 2022).

In a September 2004 letter to the President of the United States, retired U.S. Navy Admiral, James D. Watkins wrote: “The value of the oceans and coasts to the nation is immense and their full potential remains unrealized.” Nearly 20 years later, we are starting to see some of that potential, realized.

The U.S. marine seafood industry now includes a nascent offshore aquaculture sector (S. E. Lester et al., 2018; NOAA Fisheries, 2021). Offshore oil and gas drilling rigs are being replaced with offshore wind and wave farms (Kuffner, 2020; Phillips et al., 2021; Spector, 2018). Ports are expanding to service these new industries. Along the coast, flooding and erosion due to sea level rise has become a regular problem and communities are racing to find solutions ranging from large and expensive armoring strategies to removing infrastructure from harm’s way (ENVIRON Intl. Corp. & ESA PWA, 2015; Kochnower et al., 2015; Koslov, 2016; C. Lester et al., 2022; Neumann et al., 2015; Pendleton et al., 2011; Reguero et al., 2014; Reguero & Griggs, 2022).

These novel uses of the ocean have the potential to add to the ongoing degradation of the ocean and coasts. Nets and cables installed in the water column for offshore aquaculture pose the risk of entangling and drowning marine animals (Kemper & Gibbs, 2001; Young, 2015). Construction noise, such as pile driving and turbine operation, is known to produce underwater noise that can impact marine mammals (Hildebrand, 2009; Williams et al., 2015). Dredging (B. Bernstein et al., 2011), fill (B. Bernstein et al., 2011), and over-water structures damage eelgrass beds and other sensitive, shallow-water marine habitat (B. Bernstein et al., 2011; Loflin, 1995; Shafer, 1999, 2002; Trevathan-Tackett et al., 2017). Lastly, shoreline armoring has had wide-ranging impacts on beaches and associated wildlife from lost beach width to declining biodiversity (Bertasi et al., 2007; Dethier et al., 2016; Dugan & Hubbard, 2006; Griggs, 2005,

2010; e.g., Hall & Pilkey, 1991; Macdonald et al., 1994; Munsch et al., 2017; Sobocinski et al., 2010).

Government regulation is often necessary to balance competing interests and ensure shared resources are protected (Hardin, 1968; Stiglitz, 2009). In the United States, ocean management is fragmented (JOCI, 2006). Multiple agencies regulate specific activities. For example: the National Oceanic and Atmospheric Administration (NOAA) regulates fishing, and the conservation of essential fish habitat, most marine mammals, and marine endangered species. However, it does not have the authority to regulate aquaculture (Gulf Fishermen's Assn. v. NMFS, 968 F.3d 454, 465 (5th Cir. 2020)). The Bureau of Ocean Energy Management leases offshore waters over the outer continental shelf for energy or mineral extraction, but their authority did not include offshore renewable energy generation until 2005 (Energy Policy Act of 2005, Public Law 109-58).

Coastal management is more comprehensive, but governed by many agencies with overlapping and sometimes conflicting missions (JOCI, 2006). In California, for example: the California Coastal Commission regulates development in the coastal zone pursuant to the Coastal Zone Management Act (16 U.S.C. 1451-1465), the state's Regional Water Quality Control Boards regulate water quality under the state Porter-Cologne Act (CA Water Code 7 2022) and the federal Clean Water Act (33 U.S.C. 1341), and the U.S. Army Corps of Engineers regulates construction activities in tidal waters (33 U.S.C. 1344). In addition, many coastal ecosystems are home to federally endangered and threatened species, whose protection is regulated jointly by the U.S. Fish and Wildlife Service and NOAA.

In the absence of comprehensive ocean policy, the U.S. Army Corps of Engineers, through its Regulatory Program (Corps), has become the *de facto* federal agency regulating all

kinds of ocean development by virtue of its broad authority to regulate nearly all construction from the high tide line to the outer limit of the outer continental shelf. In addition to its role in permitting construction on the coast, regulates any structure or work that alters navigable waters (Section 10 of the Rivers and Harbors Act of 1899, 33 U.S.C. 403) and discharges of dredged or fill material into waters of the U.S. (Section 404 of the Clean Water Act, 33 U.S.C. 1344). In effect, the Corps regulates most kinds of construction activities, including the construction of otherwise unregulated activities, from the high tide line to the edge of the outer continental shelf (33 CFR 328, 33 CFR 329). What the Corps cannot regulate is the operation or use of whatever structure or fill it authorizes.

The Corps' regulatory identity has developed over the last century and a quarter of executive action and legal challenges. The Corps' present-day mission is: "protect the Nation's aquatic resources and navigational capacity, while allowing reasonable development through fair and balanced decisions" (USACE Regulatory Division, 2023). To accomplish this balancing act, the Corps requires applicants to avoid and minimize adverse environmental effects to the maximum extent practicable and provide compensatory mitigation for any remaining unavoidable adverse impacts to aquatic resource, typically in the form of restoring a similar resource elsewhere (33 CFR 320.4(r)).

General Permits are another tool the Corps uses to produce fair and balanced decisions. General Permits can be issued to cover categories of activities at the national, regional, or state level that are similar in nature and determined to cause no more than minimal environmental impacts (33 CFR 322.2). When a General Permit is issued, the environmental impacts are evaluated for the category of activity (e.g., U.S. Coast Guard approved aids to navigation or linear transportation project crossings that don't exceed 0.5 acre in non-tidal waters or 0.3 acre in tidal waters) over the lifespan of the permit (e.g., five years). General Permits reduce the

processing time for qualifying projects and, therefore, encourages project proponents to reduce the size of their impacts in waters of U.S. to qualify for a General Permit and avoid compensatory mitigation.

In the 1990's and early 2000's researchers began to raise concerns about the Corps' mitigation policies, particularly for projects qualifying for General Permits. Twenty-two states had lost more than 50% of their wetland area between the 1780s and mid-1980s and seven states, including California, had lost more than 80% (Dahl, 1990). Compensatory mitigation requirements were not adequate to offset permitted losses (Kentula et al., 1992; National Research Council, 2001; Sifneos et al., 1992) and completion of compensatory mitigation requirements was not adequately enforced (A. O. Allen & Feddema, 1996; Sifneos et al., 1992). To its credit, the Corps responded to this evidence by issuing the joint Corps-EPA 2008 Mitigation Rule, which overhauled the Corps mitigation policies (33 CFR 332).

However, the 2008 Mitigation Rule was written to address observed problems with wetland mitigation, specifically. Since 2008, the Corps has increasingly required compensatory mitigation for unavoidable adverse impacts to non-wetland aquatic resources, such as stream beds (IWR, 2015; USACE, 2021). However, very few compensatory mitigation projects are to address unavoidable adverse impacts to ocean and non-wetland coastal habitats (U.S. EPA, 2023). Furthermore, the 2008 Mitigation Rule may make it even harder to require compensatory mitigation for impacts to ocean habitats by, for example, requiring a real estate instrument to protect the restoration are in perpetuity (CRTF, 2016).

Despite the importance of the Corps' role in regulating ocean and coastal activities, no previously published study has looked comprehensively at the Corps' permitting practices in ocean and coastal environments. The overarching goal of this research is to better understand

the Corps permitting program as it relates to activities in the ocean and along the coast. Broadly, I am asking the following questions: Does the Corps make balanced decisions that protect ocean and coastal resources while allowing reasonable development? What role does the Corps play in sea level rise adaptation? And should the Corps be the *de facto* federal regulator of ocean and coastal activities in an age of ocean expansion? This dissertation explores the following topics:

- Chapter 2 describes the data maintained in the Corps' digital permit database, explains how to request, and prepare the data for answering a question about environmental management, and presents code used to prepare the data for analysis. In addition to sharing the raw and cleaned dataset, the methods described therein can be used by others to request and process ORM2 data for other geographic regions or time periods. I also use these processed data in the subsequent chapters.

- Chapter 3 looks at the patterns of permitting in ocean and tidal versus freshwater systems. I compare the number of permits issued, impact size, and compensatory mitigation frequency across space, time, and work type. I also test two hypotheses: 1) the types of impacts occurring in ocean and tidal systems are different from impacts in freshwater systems, such that ocean and tidal impacts do not typically meet the Corps' criteria for when to require compensatory mitigation, and 2) differences between ocean and tidal impacts and freshwater impacts do not explain the different compensatory mitigation rates.

- Chapter 4 characterizes Corps' permitting in California's coastal zone in relation to the California Coastal Commission's Sea Level Rise Policy Guidance (CCC, 2018a), and compares the use of the Corps' permit types with this Guidance to identify actions that the Coastal Commission would like to encourage, but which are not

currently easy to permit and, alternatively, actions that the Coastal Commission would like to discourage, but which are relatively easy for the Corps to authorize.

- Chapter 5 synthesizes the findings of the previous three chapters, identifies gaps in knowledge, and provides additional recommendations for how the United States can improve ocean and coastal regulation in preparation for tomorrow's environmental management challenges.

This research furthers the understanding of federal environmental policy in ocean and coastal habitats and provides practicable recommendations to bring compensatory mitigation for ocean and tidal systems up to par with that of freshwater systems and further streamline permitting for sea level rise adaptation and retreat strategies in the coastal zone. If implemented, the recommendations presented here would improve the efficiency and effectiveness at which the Corps protects ocean and coastal aquatic resources while still allowing reasonable development through fair and balanced decisions.

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CHAPTER 2: PREPARING U.S. ARMY CORPS OF ENGINEERS DIGITAL REGULATORY PERMIT DATA FROM COASTAL DISTRICTS 2012-2022

Abstract

The U.S. Army Corps of Engineers Regulatory Division (Corps) issues permits for several types of activities that affect aquatic resources. The Corps has maintained a digital database of its permits since the 1970s. The current iteration is called the Operations & Maintenance Business Information Link Regulatory Module 2 (ORM2). Since 2010, this database has been capable of tracking the number and type of permits issued, and the size and type of resource impacted over space and time. However, most of the fields in this database are not publicly available except via a Freedom of Information Act (FOIA) request and there is little documentation to aid in using the dataset for academic purposes. The aim of this paper is to: 1) describe the data maintained in ORM2, 2) present code used to prepare the data for analysis, and 3) describe how to request and prepare the data for answering questions about environmental management.

Background & Summary

The U.S. Army Corps of Engineers Regulatory Division (Corps) issues permits for discharges of dredged or fill material into waters of the United States (U.S.) under Section 404 of the Clean Water Act (33 U.S.C. 1344), structures or work affecting Navigable Waters under Section 10 of the Rivers and Harbors Act (33 U.S.C. 403), installations on the outer continental shelf under the Outer Continental Shelf Lands Act (43 U.S.C. 1333(e)), and the transport of dredged material for ocean disposal under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

The Corps has maintained a database containing information about the authorized permits since the 1980s (Dummer, 2007). Originally, the primary purpose of these databases was to manage workload, but this database was modernized in 2007 to incorporate geospatial and environmental information. Improvements to the data entry process were implemented between 2007 and 2010 (IWR, 2015). This database is called the Operations and Maintenance Business Information Link Regulatory Module version 2 (ORM2).

Basic information extracted from ORM2: the authorizing District, permit number, applicant name, project name, project location, permit type (e.g., Standard Permit, emergency permits, etc.), the date of the public notice (if applicable), the action taken (e.g., issued with conditions, denied without prejudice, etc.), and the date the action was taken, are available on a public-facing website (***https://permits.ops.usace.army.mil/orm-public***). These data from a specific Corps District can be downloaded from this website as an excel table.

Other information in the ORM2 database, such as the authorized impact area and type of aquatic resource affected, are not available to download. Instead, that information is only available to the public via a Freedom of Information Act (FOIA) request. When responding to a FOIA request for the ORM2 data, the Corps provides the tabular data and a document containing general caveats, specifically that the database and data within it change frequently in response to changing regulations. The Corps recently began providing a document to accompany the ORM2 data that explains some of the caveats about the database and describes some of the fields it contains (Appendix 2-B). However, general information about the ORM2 data is not available on the Corps' website, including information about the fields that are tracked.

Despite these challenges, the Corps receives annual requests for ORM2 data from several environmental groups. Such data have been used to evaluate the effects of rule changes on applicants (Oliver, 2016; Vanderbilt, 2013), spatial and temporal patterns in compensatory wetland mitigation (BenDor & Brozović, 2007), success of mitigation policy (Gonzalez et al., 2015; Hill et al., 2013; Inkinen, 2023; Ungaro et al., 2022), and demand for mitigation credits (Julian & Weaver, 2019; Sunda, 2013; Taylor, 2012). The potential value of the ORM2 database for evaluating and improving aquatic resource management has been discussed in the literature (C. L. Bernstein & King, 2009; Fennessy et al., 2011; Hill et al., 2013; Sutula et al., 2008). However, researchers often decide the challenges of using the ORM2 data are insurmountable (Bronner et al., 2013; Fong, 2015). The Corps is considering posting the annual datasets, but has not implemented this to date (Karen Mulligan, U.S. Army Corps of Engineers, pers. comm.). Making the ORM2 data and metadata public would make them more accessible for academic use.

The purpose of this paper is to: 1) describe the data maintained in ORM2, 2) present the code used to prepare the data for analysis that could be used by others requesting similar information for future dates or of different geographic scopes, and 3) describe how to request and prepare the data for answering a question about environmental management. I used the resulting dataset to assess differences in compensatory mitigation requirements between impacts occurring in different habitat systems (Chapter 3) and to evaluate the Corps Regulatory Program's role in coastal risk reduction (Chapter 4). In addition to the dataset, the methods described herein can be used by others to request and process ORM2 data for other geographic regions or time periods.

How the Corps Generates the Data

The following overview of the data entry process is based on personal experience as a Regulatory Project Manager from 2019 to the present. Figure 2-1 depicts the data entry forms, what fields each form populates, and how the forms/fields are related to each other.

Folder, Contacts, and (Project) Location

When an applicant submits a request for a permit to the Corps, a Regulatory Project Manager creates a folder in ORM2 and gives the project a name. The system assigns a unique identification number to the folder (ACTION_FOLDER_ID) and a corresponding Department of the Army File Number (DA_NUMBER). Within the folder, the Project Manager enters information about the project location, point of contact, aquatic resource(s) on the project site(s), and the jurisdictional status of these resources. This folder level information applies to everything within it.

Aquatic Resource

The Project Manager quantifies, names, and classifies the aquatic resource(s) within the project site. The Corps uses a modified version of the Cowardin classification system (Cowardin et al., 1979) to classify aquatic resources.

Action

The Project Manager or a supervisor creates a form for the requested type of action (e.g., Standard Permit, Letter of Permissions, or General Permit). For General Permits, the Project Manager determines how many single and complete actions are required to authorize the

project and creates each action within the folder. Single and complete is defined at 33 CFR 330.2(i). A permit for linear projects (e.g., roads or transmission lines) typically requires a separate action for each water crossing, while a permit for a housing development or a flood control basin is typically a single action. Some non-linear projects, such as to remove a pipeline crossing and stabilize that section of stream bank, also require multiple actions: one for each category of activity covered by separate General Permits (e.g., Nationwide Permit 12 for removing the pipeline and Nationwide Permit 13 for stabilizing the bank). If a permittee needs more time to complete a project or the project changes after a permit is authorized, the Project Manager will add a new action (e.g., permit modification, General Permit reverification) to the folder.

For every action, the Project Manager enters additional information including the project description, legal authority to permit the activity, whether compensatory mitigation is required, and the type of work being authorized (e.g., transportation, structure, or development).

Impacts and Mitigation

Under each action, the Project Manager adds the associated impact(s) and mitigation (if applicable) affecting the aquatic resource(s). The Project Manager enters a descriptive name for the impact (e.g., coffer dam), identifies the type of resource affected, independent of the linked aquatic resource (e.g., harbor/ocean, river/stream, tidal wetland, etc.) and enters the impact size (linear length, length and width, area, volume) in English units under the appropriate jurisdictional activity type (e.g., fill, dredging, structure, etc.). Under mitigation, the Project Manager also enters information about the type and amount of mitigation required.

How the Corps Checks Data Quality

Because data are entered by Regulatory Project Managers—whose primary job is to process permits, not generate data—there are a variety of challenges in using these data. For example, the information entered into open text fields can provide useful context but contains so much variability in the terms used and in the spelling that text analysis is virtually impossible. Typographical errors can also affect the impact/mitigation size records. Common mistakes are missing decimal points and an impact area in square feet labeled as acres. Furthermore, the database itself is very dynamic. Fields are added or changed in response to changes in regulations and internal guidance and policy.

Since 2014, the Corps has taken steps to introduce quality assurance and quality control measures during data collection, including the use of drop-down selector fields (which eliminates spelling and phrasing differences), mandatory fields (which reduces the amount of missing data), warnings for certain common mistakes (e.g., entering an impact amount greater than 10 acres or not allowing records/selections based on the selected permit authority or jurisdiction), and maintaining standard operating procedures.

Methods

Software Used to Process the Data

I performed all data organizing and processing steps using R (v4.3.0, R Core Team (2022)) run in RStudio. I wrote several R functions to aid in the importation, cleaning, and restructuring of the data and compiled these functions and the dependent look-up tables into an R package called “ORMimportr” (v0.1.1, Protopapadakis F. (2023a)) available for download and

installation from the Comprehensive R Archive Network (CRAN; ***https://cran.r-project.org***) within R.

Data Acquisition

I obtained the ORM2 permit data through a Freedom of Information Act (FOIA) request submitted to the Corps on 10 January 2023. I requested a digital copy (excel of csv file) of records stored in the ORM2 database containing information about permits authorized by the 20 Corps Districts with a maritime coastline between 1 January 2012 and 31 December 2022. I selected this time frame because some of the fields I needed for my later analysis had large numbers of missing values prior to 2012. My data request also identified the desired data fields. The Corps took five months to process the request.

In the raw data and in most cases, each record represents a single impact or mitigation record. However, in certain situations, multiple impacts are entered on the same form. For example, when entering the removal and replacement of a structure. In these cases, one record represents two impacts. The raw (and processed data) are available on the data repository Dryad (***https://doi.org/10.5061/dryad.jwstqjqgn***). A copy of the FOIA request is provided in Appendix 2-A. A copy of the document received with the data describing caveats about the data and some of the fields is provided in Appendix 2-B. Appendix 2-C contains a description of the data fields and definitions for the standard abbreviations found within the data entries.

Computational Processing

Figure 2-2 illustrates the workflow followed for processing the ORM2 data. The raw data arrived in ".xlsx" format and was saved as ".csv" to aid in importing into R. Missing values in the

raw data can confuse the base-R tabular-data importing function, so I used the "field.class.lookup" table from my "ORMimportr" package, to import the data into R with the correct classes (e.g., character, date, numeric, etc.) for each field. The Corps reports impact size in English units (feet, square feet or acres, and cubic yards) by default, but this information is stored in metric units in ORM2 (Karen Mulligan, U.S. Army Corps of Engineers, pers. comm.). I chose to use the English units because the Corps' regulations specify thresholds in English units. Therefore, results presented in English units would be directly relatable to policy recommendations and therefore more meaningful for decision makers.

The dataset I received had a few hundred records with incorrect geographic identifiers, such as county and state names that are not part of a District's area of responsibility. While mismatches like this can be legitimate in certain situations, such as under a workload sharing agreement between two Districts and approved by Corps Headquarters or when the District boundaries have shifted over time (Karen Mulligan, U.S. Army Corps of Engineers, pers. comm.), it warrants a closer look. I used the "geo_checker" function and the "usace.lookup" table from the "ORMimportr" package to identify mismatches by comparing the state and District in the data with the look-up table. Correct state and county names were manually identified outside of R based on a "Google Maps" search of other geographic fields such as the water's name or the latitude and longitude of the impact site. I did not change the District value, because this was automatically generated based on the assigned duty station of the Regulatory Project Manager processing the permit and not likely to be an error. For someone applying these methods to a new data request, this step is time consuming and is only necessary if the county/state information is needed to filter the data or important to future analysis. For the final dataset, I eventually filtered by county to retain only data from coastal counties as defined by the NOAA Office for Coastal Management using Geographic Information Systems (GIS) data produced by the U.S. Census Bureau (Office for Coastal Management, 2020).

The raw data includes multiple fields that describe the impact size. These are named based on the jurisdictional activity type, specifically: fill (FILL), dredged fill (DRG_FILL), dredging (DRG_REMVL), structures (STRUC), or structure removal (REMVL) and the unit of measure: length (LINEAR_FT, LENGTH_FT, WIDTH_FT), area (ACRES), and volume (VOL_CUFT). Districts check their data in the first quarter of the new fiscal year for records from the previous fiscal year to ensure data are correct before the data are used to generate annual reports to Congress and other requesters (Karen Mulligan, U.S. Army Corps of Engineers, pers. com.). However, errors still occur. As a quality check on the impact area entered, I used the "find_outlier" function from the "ORMimportr" package to identify any impact area that was greater than the 99.9th percentile of all impacts for that type (e.g., FILL, DRG_FILL, etc.). Since I elected to focus on impact area in my subsequent analysis, I only performed this check on the area fields (ACRES). However, other units of measure can be supplied as a parameter to the "find_outlier" function. I also separated temporary and permanent impacts because I expected temporary impacts to be larger on average than permanent impacts. The outlier threshold values identified for permanent impacts by jurisdictional activity were FILL = 78.42 acres, REMVL = 315.54 acres, STRUC = 6.78 acres, DRG_FILL = 462.57 acres, and DRG_REMVL = 393.24 acres. The outlier threshold values identified for temporary impacts by jurisdictional activity were FILL = 257.42 acres, REMVL = 198.6 acres, STRUC = 67.91 acres, DRG_FILL = 2480.24 acres, and DRG_REMVL = 1226.29 acres.

Just because a record was flagged as an outlier, does not mean that the record is incorrect. Therefore, I systematically reviewed all potential outliers manually outside of R. I applied a standardized decision framework to accept, correct, or remove a record. The field, "outlier_decision_logic," identifies the reasoning behind the action taken and can take the following values: "Description confirms impact size," "Description supports impact size,"

“Description supports unit conversion,” “Description supports other change,” “Description does not contradict impact size,” “Description does not support impact size,” or “Not flagged for review.”

I kept the original impact amount if: at least one of the descriptive fields mentions the impact size and the size matches the amount entered (“Description confirms impact size”), at least one of the descriptive fields mentions the impact size and is approximately the same or larger than the amount entered (“Description supports impact size”), or the descriptive fields describe an activity that could be as large as the amount entered (“Description does not contradict impact size”). I corrected the impact amount if the descriptive fields describe a different amount that could be computed from the original amount via a unit conversion such square feet to acres (“Description supports unit conversion”) or the descriptive fields clearly describe a different impact area (“Description supports other change”). I removed the record if the descriptive fields did not contain enough information to corroborate the entered amount or provided conflicting information, such as when the impacts described were most likely very small and temporary but entered as very large and permanent (“Description does not support impact size”).

Impacts not flagged as potential outliers were not reviewed (“Not flagged for review”). The value of the “outlier_decision_logic” field can also be viewed as a description of the level of confidence in the impact size for that record. Arranged in order from most confident to least confident, the “outlier_decision_logic” field values are “Description confirms impact size,” “Description supports impact size,” “Description supports unit conversion,” “Description supports other change,” “Description does not contradict impact size,” “Not flagged for review,” and “Description contradicts impact size.”

Table 2-1 quantifies the results of the outlier review. Of the 937 impacts flagged as a potential outlier out of 548,997 records in the dataset, 54% were confirmed or supported by the description, 33% were unchanged for lack of contradictory evidence, 11% were changed based on the description, and 2% were removed from the dataset because the project description didn't support the very large, reported impact size.

For a small fraction of the data (581 records or 0.11%) Regulatory Project Managers recorded impacts to non-jurisdictional features in ORM2. This is one example of how changes in policy effect the database. In the early 2000's, jurisdictional and non-jurisdictional waters in the project area were both entered in ORM, but current practice is to only enter jurisdictional waters (Karen Mulligan, U.S. Army Corps of Engineers, pers. com.). I defined excluded waters as records with 1) a "WATERS_TYPE" of "DRYLAND"; 2) a "WATERS_TYPE" that starts with "EXCLD" indicating an exclusion under the Clean Water Rule if the "END_DATE" was between 29 August 2015 and 22 December 2019, inclusive; 3) a "WATERS_TYPE" that starts with "B" indicating an exclusion under the Navigable Waters Protection Rule if the "END_DATE" was between 22 June 2020 and 29 August 2021, inclusive; or 4) a "WATERS_TYPE" of "UPLAND" and a "COWARDIN_NAME" of either missing ("NA") or "U-UPLANDS." The dates given apply to the general effective dates of the respective definition of waters of the U.S. even though these rules may not have been in effect during that time for all states due to various court rulings enjoining the rules for a subset of states.

Some fields contain missing values that could be filled in using other information in the data. To fill in missing data in the "COMPENSATORY_MITIGATION_RQD" field, I extracted a vector containing the action identification numbers ("ACTION_ID") of all records for which mitigation data were entered and used this to change the value to "Yes" for all mitigation records with the same "ACTION_ID". By using information about the type of impact from other fields, I

was able to fill in missing values for the permit authority. Specifically, if the authorized impact type was “FILL” and the resource type was “Ocean/Harbor,” then missing values were replaced with “Section 10/404.”

Through data exploration, I discovered that certain standardized fields (e.g., those selected from a drop-down menu) contained values that indicated the record had been migrated into ORM2 from a previous database, rather than information related to that field. These field-value pairs are “PERMIT_AUTHORITY” and “historical,” “IMPACT_TYPE” and “historical undertermined” [sic], “COWARDIN_NAME” or “MIT_COWARDIN_NAME” and “historical data.” I replace these values with “NA” for their respective fields. I also replaced any “NA” values in the numerical data with “0” to facilitate restructuring of the data. Impact sizes of “zero” were removed from the dataset after restructuring.

During data entry, the Regulatory Project Manager selects the type of impact being entered from a drop-down menu (“IMPACT_TYPE”). Then they enter the amount and units in one or more of several fields depending on the type of jurisdictional activity (“AUTH_*”). As a result, the ORM2 data contains multiple fields representing the impact size for each jurisdictional activity as measured by up to three different types of units (e.g., feet, acres, cubic feet). This means a single record can contain multiple impact amounts under any of several impact size fields, where the field name indicates the type of impact (e.g., fill, removal, structure, dredging), dimension (length, width), and unit of measure (feet, acres, cubic yards). For example, the removal and replacement of a dock might be entered under the same impact name with the impact area of the old dock under the “AUTH_REMVL_ACRES” and the impact area of the new dock under “AUTH_STRUC_ACRES.” To restructure the data so that each record represented a single impact, I pivoted (lengthened) these data so that each row of data represents a single record of an impact, removed records with no data (e.g., 0 value), and

assigned each record a new unique identifier ("impact_id"). This step also created fields containing the impact size named for the unit of measure and the jurisdictional activity type taken from the original field name, "auth_impact_type." I also created a new field called "impact_type" which contains a condensed version of the information from the "IMPACT_TYPE" field.

The "WORKTYPE" field also required restructuring to be useful. This field contains as many as three independent selections that describe the type of work associated with the impact. The field is populated when the Regulatory Project Manager selects between one and three work types from a drop-down menu. The menus are identical and independent of each other. The options contain nested levels of detail, for example "Development, Residential, Single Family" or "Development, Institutional." If the Project Manager selects more than one work type, the selections are concatenated together into a single value in the order they are selected. The result is 8,137 unique values in the "WORKTYPE" field. To make this field somewhat usable, I first separated each selected work type into a separate field: "worktype1," "worktype2," and "worktype3." If the Project Manager had only selected one work type, then "worktype2" and "worktype3" would be "NA." Next, I created three new fields ("worktype1A," "worktype2A," "worktype3A") containing only the first level of detail (e.g., "Agriculture," "Transportation," "Development"). Then, I concatenated the three simplified work type fields in alphabetical order into a single field ("worktypeA_all").

Values in the "COWARDIN_NAME" field of the raw data follow a pattern where the Cowardin code (a string of letters and numbers that describe the system, subsystem, class, subclass, and modifiers according to the Cowardin classification system (Cowardin et al., 1979)) and the code's description are supplied, separated by an en-dash ("-"). After data exploration, I determined that the descriptions were not standardized and contained a variety of non-standard

abbreviations and spelling errors. Therefore, I extracted the Cowardin code from the "COWARDIN_NAME" field and used that to add a field containing a standardized description of the Cowardin code from the "cowardin.lookup" table in the "ORMimportr" package. I created the "cowardin.lookup" table using the codes and descriptions provided in *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979).

To allow for tiered analysis, I also created several related fields containing increasing complexity of the Cowardin code (e.g., system-only, system-subsystem, and system-subsystem-class) using the standardized "impact_cowardin_code" field. I also used this "impact_cowardin_code" field and the "RESOURCE_TYPE" field to identify special aquatic sites in a field called "impact_sas_detail." Special aquatic sites are defined in the EPA's 404(b)(1) Guidelines at 40 CFR 230 Subpart E and include wetlands, coral reefs, and mudflats. First, I identified wetlands using the "RESOURCE_TYPE" field as this field proved to be more reliable than the Cowardin code for identifying wetlands. Next, I identified additional wetlands when the "impact_cowardin_code" field contained the following class descriptors: "EM" (emergent marsh), "SS" (scrub-shrub wetland), and "FO" (forested wetland). I used the Cowardin class descriptor "US" (unconsolidated shore) and the subclass descriptors "3" (mud), "4" (organic), or "5" (seasonal, herbaceous, non-submerged vegetation) to identify mudflats; the class-subclass descriptor "AB3" (aquatic bed, rooted vascular) to identify submerged aquatic vegetation (SAV); and the Cowardin class-subclass descriptor "RF1" (reef, coral) to identify coral reefs.

Since the field names in the raw data were in ALL CAPS, I used lowercase for all my created field names. For example, the field "end_year" contains the year the permit decision was finalized, extracted from the "END_DATE" field. To further aid interpretation of the data, I added fields containing the name of the Corps District, the Corps Division code, and the name of

the Corps Division using the “usace.lookup” look-up table in the “ORMimportr” package. I generalized the permit type so that the different types of General Permits (RGP = Regional General Permit, PGP = Programmatic General Permit, and NWP = Nationwide Permit) are all labeled as “GP.” Finally, I removed fields in which all the values were the same (e.g., all records were “NA” for that field), any records containing the word “delete” in the project, impact, or water name fields, and records for which the impact area was identified as “upland” (e.g., not jurisdictional waters), and all records that were not of impacts (e.g., mitigation records).

Final Data Summary

The final dataset contains 429,728 impacts authorized in coastal counties from 02 January 2012 to 31 December 2022 and described by 74 variables. It is available on the data repository Dryad under the file name “coastal_corps_permit-impacts_2012-2022_clean.csv” (Protopapadakis F., 2023b). Appendix 2C describes both datasets and the fields they contain. The distribution of impact sizes approximates a log-normal distribution but remains slightly skewed right, indicating that very large impacts are relatively rare and small impacts are very common (Figure 2-8).

Figure 2-3 shows the percent of records with missing values (e.g., “NA”) in each field. This information can be useful when selecting fields for analysis. It is important to note that missing values for descriptive fields can be structural (e.g., some fields are associated only with General Permits and all records for individual permits would therefore have missing values for those fields) or “real” (e.g., the information was not entered). The fields that do not have missing values are “ACTION_FOLDER_ID”, “ACTION_ID”, “IMPACT_ID”, “DISTRICT”, “DA_NUMBER”, “ACTION_TYPE”, “COMPENSATORY_MITIGATION_RQD”, “END_DATE”, “CLOSURE_METHOD”, “IMPACT_DURATION”, “IMPACT_TYPE”, “WATERS_NAME”,

“end_year”, “geo_decision_logic”, “state”, “coastal”, “state_name”, “change_made”, “division”, “district_name”, “division_name”, “comp_mit_rqd”, “auth_impact_type”, “ACRES”, “acres”, “impact_id”, “impact_type”, “permit_type”, “permit_authority”, and “district”.

In addition to quantitative analysis, these data can also be used for geospatial analysis. Figure 2-4 is a sample plot, showing the geographic distribution of impacts by size and the Cowardin system (e.g., Marine, Estuarine, Riverine, Riparian, Limnetic, Palustrine). A note on the Cowardin Classification: 46% of the records are described at the subsystem level and 44% are described at the class level of detail (Figure 2-5). In contrast, 5% have no more than the system level. Subclass is the highest level of detail in the data and only accounts for 5% of records.

Data Records.

“coastal_corps_permits_2012-2022_raw.csv”

Raw permit data as received from the Corps via a FOIA request and saved as a “.csv” file type. This dataset contains 549,093 records of permit actions described by 84 variables. The “Field descriptions” section, below, describes the variables and how the data are generated.

“processing_ORM2_data.R”

R code used to create the clean data (“coastal_corps_permit-impacts_2012-2022_clean.csv”) from the raw data (“coastal_corps_permits_2012-2022_raw.csv”). For the code to work, you will also need to install the “ORMimportr” package from the Comprehensive R Archive Network (CRAN) repository. Note: All the files in “coastal_corps_permits_2012-

2022.zip" must be in your working directory for this code to work. The "ORMimportr" package includes several look-up tables used to standardize, verify, and contextualize the raw data. These are named: "coastal.counties.lookup," "cowardin.lookup," "field.class.lookup," "net.lift.lookup," "nwp.lookup," and "usace.lookup."

"validity_testing.R"

R code used to check the rate of internal inconsistencies present in the field containing impact area ("acres").

Technical Validation

Due to the nature of the data creation, reliability is a concern. It is hard to validate the data in ORM2 without comparing each result to the corresponding Corps decision document. However, there are a few ways the fields in the data can be checked for internal consistency. Fields that provide similar or related information can be compared to identify records with inconsistent values. One example is with the fields "RESOURCE_TYPE" and "COWARDIN_NAME" (and its derivatives, e.g., "impact_cow_sys"). A comparison of these fields reveals that approximately 80% of records with a resource type of "Tidal Wetland" were classified as "marine" or "estuarine" (as expected), but a surprising 15% (2,802 of 18,857; Figure 2-6) were classified as "palustrine." Similarly, 82% of records with a resource type of "Lake" were classified as lacustrine (as expected), but 10% were classified as marine or estuarine (1,614 of 15,890). While the lacustrine system can be tidally influenced, the ocean-derived salinity must be less than 0.5 parts per thousand (ppt) (Cowardin et al., 1979). In this latter case, the options under "RESOURCE_TYPE" do not include a value that clearly describes an open-water estuarine system that is not a harbor. Based on the above, I recommend that researchers

interested in the types of aquatic resources affected by Corps permits should use "RESOURCE_TYPE" to identify wetlands, but the "impact_cowardin_code" and its derivatives to identify other types of aquatic resources.

A comparison of the "auth_impact_type" and "permit_authority" fields reveals that while approximately 95% of all records described as "Section 404" were also described as "Fill" (as expected), approximately 1% (2,359 of 259,032) were described as "Structure" (Figure 2-7). Of these, 373 (16%) are classified as marine, estuarine, tidally influenced riverine, or resource type of "Tidal Wetland"). As marine or tidally influenced waters are Section 10 by definition, these records could be manually reviewed to determine the correct permit authority depending on the research question. On the other hand, there are 957 records described as a non-tidal wetland based on the "RESOURCE_TYPE" field. In these cases, the "WORKTYPE" field tends to describe activities that would be considered a discharge of fill (e.g., housing developments, utility line crossings, and water control structures), so these records should be manually reviewed to determine the correct "auth_impact_type" if that field were important to the analysis. Another 2,711 (4%) records are described as Section-10-only involving fill. If "fill" is the correct, then the permit authority may be better characterized as Section 10/404. However, because discharges of fill require a Section 10 permit if the activity is located in Navigable Waters and because Section 404 jurisdiction ends three miles seaward of the shoreline, while Section 10 jurisdiction can extend to the edge of the continental shelf, these records are less concerning, but might also be reviewed depending on the research question.

Similarly, to check the internal consistency of the reported impact area, there are three description fields in the ORM2 data that the numerical impact area can be compared to. These are: "IMPACT_NAME," "PROJECT_DESCRIPTION," and "FOLDER_DESCRIPTION." The Regulatory Project Manager enters the impact name at the same time they enter the impact

amount. Sometimes the name includes the impact amount. The project description is intended to be the authorized project description and should contain the authorized impact size. The Project Manager enters the project description on the action screen, which is separate from where, and often when, the impact amount is entered. The folder description is intended to be the proposed project description and is required at the time the folder is created although sometimes Project Managers only enter a placeholder character (e.g., "." or "a"). Due to these factors, the project description and impact name are more reliable than the folder description when determining the accuracy of the entered impact amount, but all are subject to error themselves.

To quantify the internal consistency for impact area in this dataset, I manually compared "IMPACT_NAME," "PROJECT_DESCRIPTION," and "FOLDER_DESCRIPTION" with the entered impact area of a random sample of 500 records in the processed data. Upon initial review of the first sample of records, I determined that many records in the sample did not have any numerical values in at least one of the descriptive fields. Further review revealed that the descriptive fields for many of the remaining records in the sample did not contain enough information to allow for a comparison with the impact areas. Therefore, I continued to sample the data without replacement until I had 500 records in the sample that contained a description of the impact area in the descriptive fields.

In excel, I extracted the impact areas from the descriptive fields to compare them with the impact areas entered in the impact size field. Where there were discrepancies between the impact size information in the description fields, the impact name (which sometimes contained the impact amount) took precedence over the project description and the project description took precedence over the folder description.

To compare the entered value (as entered by the Regulatory Project Manager in ORM2) with the described value (as extracted by me from the descriptive fields), I rounded both values to two significant digits, subtracted the described value from the entered value, and then divided the result by the order of magnitude of the average of the entered value and described value. To accommodate acceptable differences, such as rounding, I accepted records with an adjusted difference of +/- 0.1 as consistent. For example, an entered value of 0.01 acre with a described value of 0.0106 would have an adjusted difference of $(0.01 - 0.011)/0.01 = -0.1$, an entered value of 120 acres with a described value of 116 acres would have an adjusted difference of $(120 - 115)/100 = 0.05$ and both would be accepted as consistent. In contrast, an entered value of 0.337 with a described value of 0.322 has an adjusted difference of $(0.34 - 0.32)/0.1 = 0.2$ and would not be accepted.

Of the 500 compared records, the described impact area was consistent with the entered impact size for 82% of records, including 76% of which were equal (Table 2-2). While 18% of records had internal inconsistencies, the magnitude of the differences is unlikely to affect analysis of impact area. A two-sided, paired t-test comparing the entered and described impact areas reveals a mean difference of 0.035 acre, which is not significant (P = 0.212, alpha = 0.99).

Interestingly, the entered value was less than the described value for 55% of the inconsistent records. While this might appear to reflect a slight systematic bias, there is a more likely explanation. First, inconsistencies do not mean that the description fields are "correct" and that a difference between the description fields and the impact area is an incorrectly entered impact area. Second, ORM2 data entry is iterative, with the information about the "folder" entered when the application is received, and the information about the impact and the project description entered closer to when the permit is authorized. During the permit review process, applicants may find ways to reduce their impact. The smaller impact size would be reflected in

the entered impact amount, but may not be reflected in the folder or project description. Third, Regulatory Project Managers tend to use the project description to summarize the project's impacts, while these impacts are broken down by duration of the impact (e.g., temporary or permanent), each aquatic resource and classification on the project site, and by the type of impact (e.g., "fill," "removal," etc.). While I accounted for this when deciding if the descriptive fields had enough information to make a fair comparison, the described impact areas were not always clear, and some may have been a total for the project.

The above analysis demonstrates that the effect of errors in the ORM2 data can be minimized by comparing similar fields with each other. It also demonstrates that errors are not likely to have a large impact on analysis, given the large number of records available in the data and the low inconsistency rate.

Usage Notes

In addition to the processed dataset described here, anyone can modify the "R" code provided to reanalyze the raw dataset to suit their needs or submit a FOIA request for the spatial and temporal scope of their choosing. To assist with selecting geographic areas, a map showing the area covered by each Corps District can be found here: ***https://regulatory.ops.usace.army.mil/offices/***. I also provide a copy of my FOIA request in Appendix 2-A as an example and a copy of the caveat document received with the data in Appendix 2-B. Any future FOIA request that specifies the same fields can be processed as described above.

When using ORM2 data, the fields to be most cautious about are those that accept open-ended responses and are not used internally for tracking workload or performance. Examples of

this are the fields containing comments, names, or descriptions (e.g., FOLDER_COMMENTS, WATERS_NAME, and PROJECT_DESCRIPTION). This group does not include the open-ended numeric fields, such as impact and mitigation amounts, because these amounts are used internally. The location information (fields specifying latitude, longitude, county, and the 8-, 10-, and 12-digit Hydrologic Unit Code (HUC) is moderately reliable.

Potential errors to be aware of in the latitude/longitude fields are an incorrect positive value for longitude, coordinates from a datum/projection that were not converted to NAD83, and waters coordinates that match the project coordinates for long linear projects. The latter is a concern because it means the waters coordinates were copied from the project midpoint and do not relate to the location of the aquatic resources. These errors are then passed on to the system-generated fields that rely on the project location, such as "COUNTY," and the "HUC" fields.

Fields that the Corps uses internally (e.g., for tracking workload or assessing performance) receive extra scrutiny, and are generally the most reliable. These are fields for dates, impact duration and loss, compensatory mitigation requirement, permit number and name, closure method, action type, impact and mitigation type, impact and mitigation amounts. Another consideration is how well the options in a drop-down menu describe the activity being authorized. For example, the "WORKTYPE" field does not include an option for voluntary restoration, which can make it hard to distinguish an impact associated with a voluntary restoration project from an impact resulting from the fulfillment of a compensatory mitigation requirement. The "RESOURCE_TYPE" field is another example. For that field, some options are more reliable (e.g., Tidal Wetland vs Non-Tidal Wetland) while others are less reliable (e.g., "lake"). I found the "impact_type" field to be generally more reliable than the "auth_impact_type" field, probably due to changes in the way impact size is entered over the years.

What follows are comments about appropriate ways to summarize the ORM2 data.

Meaning of each record

Each record in the raw data does not represent a single impact. Nor does it represent a single permit action. To facilitate analysis, I restructured the data such that each record refers to a single impact. This means that a count of the number of records of a particular type, is a count of the number of impacts authorized, NOT the number of projects authorized. It is also possible to condense the data so that each record represents a single project. Factors to consider if doing this are 1) General Permits for linear projects would be expected to contain multiple "Actions" with the same end date; 2) reverifications of the same action would most likely be under the same folder with different end dates; 3) Complex actions may occur in phases and would also have multiple actions under the same folder with different end dates and possibly different associated types of permits.

Each impact record represents the authorized impact size, not the as-built condition. Project proponents may seek authorization for a larger impact area than needed to cover their "worst-case scenario". For a variety of reasons, including changing economic fortunes and legal challenges to state or local building permits, some authorized projects are never constructed (pers. obs.).

Geographic region

The Corps Regulatory Program is highly decentralized. Regulatory authority is delegated down from the Secretary of the Army to 38 geographically distributed District Engineers.

Policies are tailored at the District level based on regional differences, which could result in regional differences in permitting practices and in ORM data entry polices.

Geospatial information

ORM2 uses the NAD83 datum (EPSG:4269 ***https://epsg.io/4269***). The Corps uses the appropriate UTM zone projection. Geographic misalignment can occur if the applicant provides geographic coordinates for the project location in a different geodetic datum.

Statistics generally

Depending on the research question, these data can be viewed either as a sample or a census. For questions about the Corps' evaluation of permits, these data are a complete enumeration rather than a sample, so statistical tests for difference are not necessary. However, for more generalized questions about how aquatic resources are affected by development in the U.S., the Corps' data may be considered a sample of the impacts occurring in aquatic resources, because not all impacts are reported to the Corps and not all impacts authorized by the Corps are acted on. Some minimal types of impacts are covered under non-notifying General Permits and some impacts (large or small) are unauthorized, making the sample potentially biased. However, the Corps also tracks the resolution of potentially unauthorized activities which are reported. It may be possible to estimate this potential bias by looking at how many of these potential violations were resolved because they were eventually authorized by a non-notifying General Permit versus how many were resolved by issuing an after-the-fact permit or by requiring the violator to restore the aquatic resource.

Summarizing impact area

The geometric mean is a more appropriate tool for summarizing the log-normal distributed impact size because it more accurately represents the central tendency of the data (Limpert et al., 2001). While the median is similarly less sensitive to very large observations it is also less sensitive to very small impacts. In comparison to the geometric mean, the median and arithmetic mean overestimate central tendency (Figure 2-8).

Very small impacts

The data contain thousands of impacts entered at very small sizes, including 3,279 smaller than 1 sq. ft. (0.09 m^2). Sometimes, a permittee doesn't act on the authorization before the permit expires. In these cases, the Corps can "reverify" the activity (General Permits) or modify the permit (Letters of Permission and Standard Permits). Over time and across the Districts, Regulatory Project Managers have applied different methods to avoid "double-counting" the impacts. In some instances, the impacts associated with the re-verified impacts were entered as zero, or some impossibly small number. However, sometimes the authorized impact area is actually very small. For example, a single 6-inch diameter geotechnical boring would have an impact area of 0.2 square feet (4.5e-06 acre or 1.8e-06 hectares). I recommend researchers think carefully about the implications of including or excluding these very small impacts for their specific research questions when using the Corps' permit data.

Code Availability

The R program used to assist with importing, cleaning and quality checking the ORM data, "ORMimportr" (v0.1.1 (Protopapadakis F., 2023a)) is available for download and

installation into R or RStudio on the Comprehensive R Archive Network (CRAN) website at ***https://cran.r-project.org***. The package contains functions and look-up tables that assist with cleaning and quality checking tasks.

Tables

Table 2-1: Results of outlier review.

Outlier Decision Logic	Change Made	Count	%
Description confirms impact size	No	324	34.6
Description supports impact size	No	182	19.4
Description supports unit conversion	Yes	86	9.2
Description supports other change	Yes	17	1.8
Description does not contradict impact size	No	307	32.8
Description does not support impact size	Removed	21	2.2
Total		*937*	*100.0*

Table 2-2: Comparison of entered impact area and described impact area.

Result	Count	%
equivalent	381	76.2
consistent	28	5.6
greater than	41	8.2
less than	50	10.0
Total	500	100.0

Figures

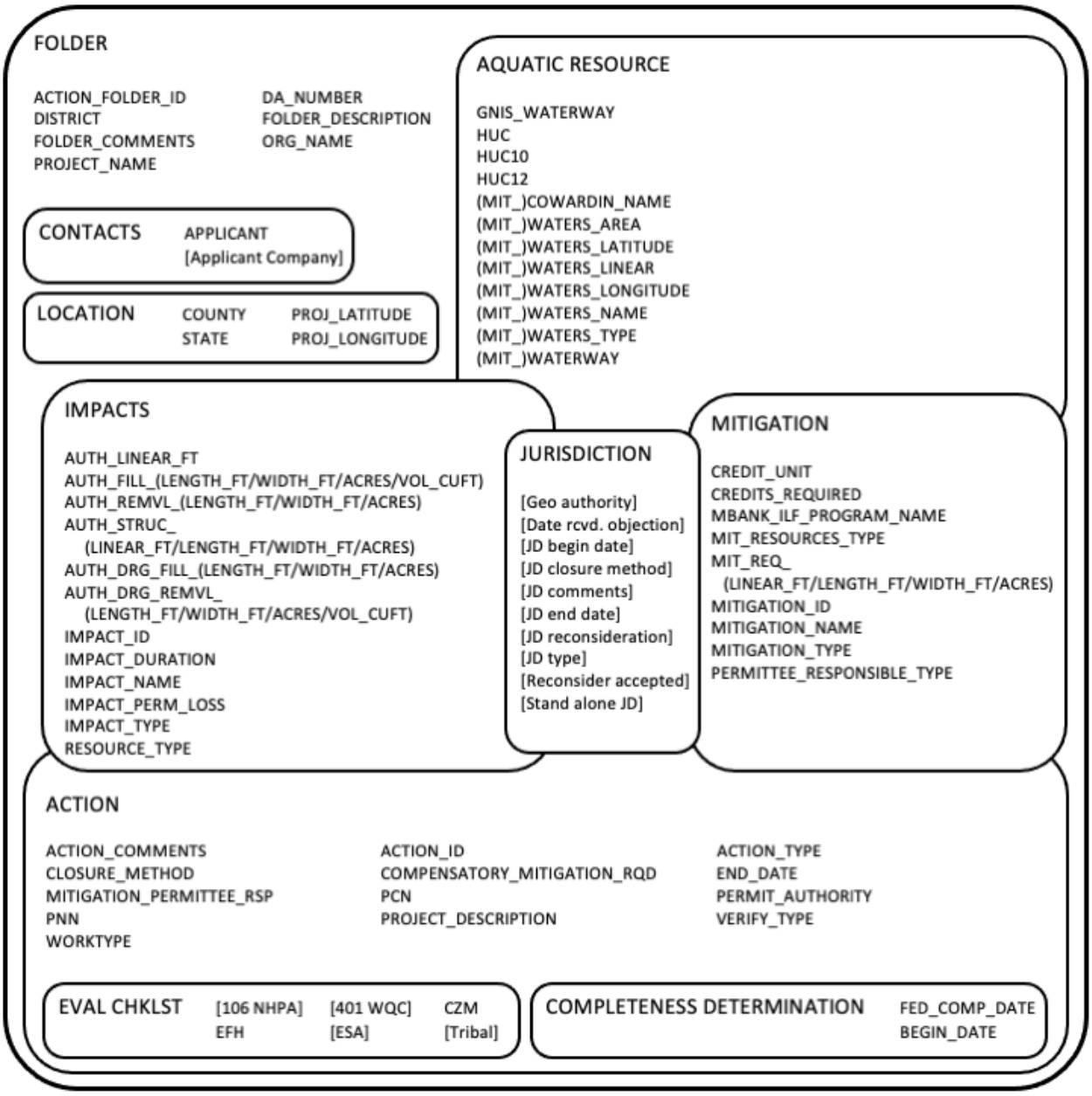

Figure 2-1: Schematic of ORM2 fields relative to each other. Field names in ALL CAPS are part of the raw dataset. Fields with similar names are written with the differences contained in parenthesis and separated by a backslash (e.g., "(MIT_)WATERS_AREA" means "MIT_WATERS_AREA" and "WATERS_AREA"; "AUTH_REMVL_(LENGTH_FT/WIDTH_FT/ACRES)" means "AUTH_REMVL_LENGTH_FT," "AUTH_REMVL_WIDHT_FT" and "AUTH_REMVL_ACRES"). Text in square brackets are fields entered by the Regulatory Project Manager, but not part of the raw dataset, and the names may not correlate with an ORM2 field name.

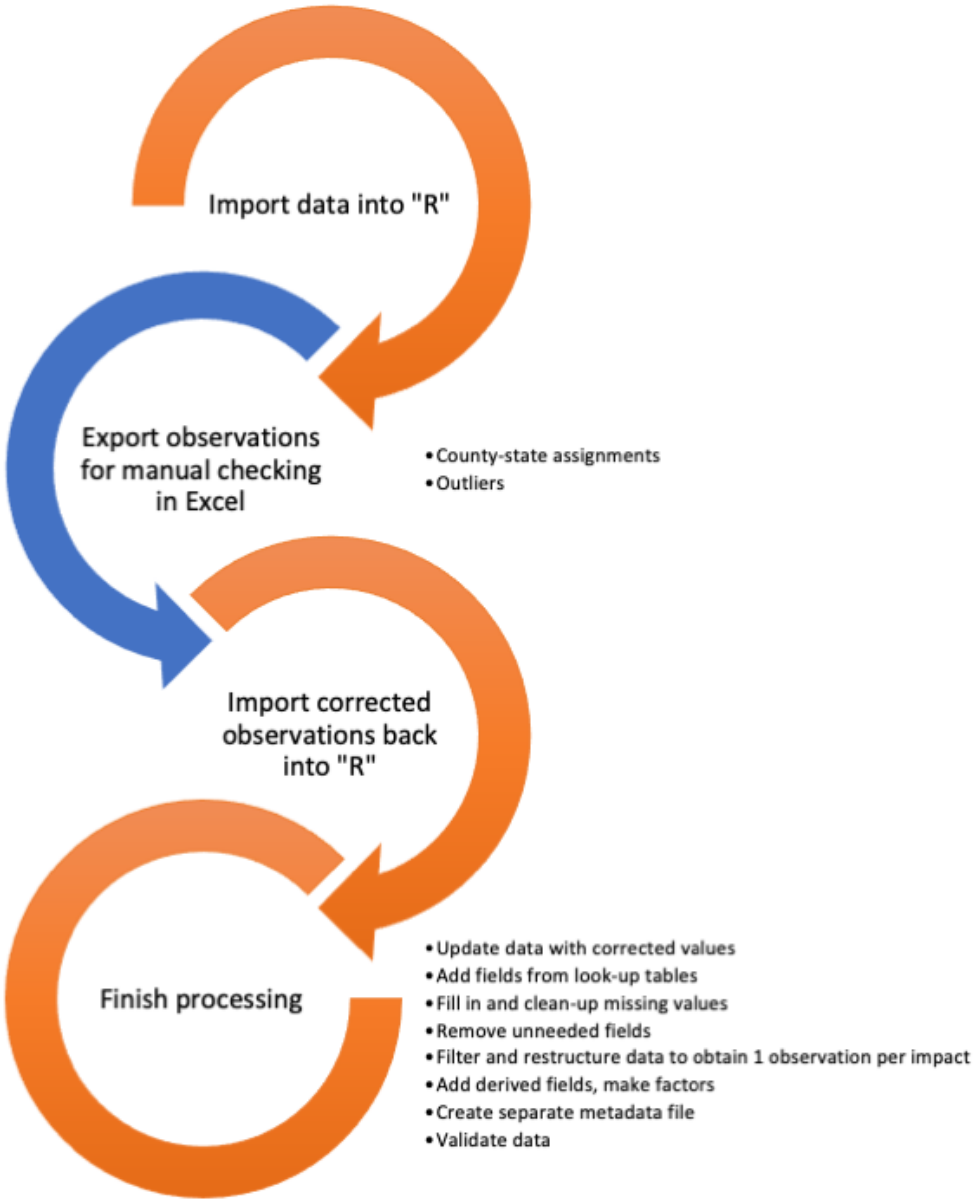

Figure 2-2: The workflow used to process the ORM2 data.

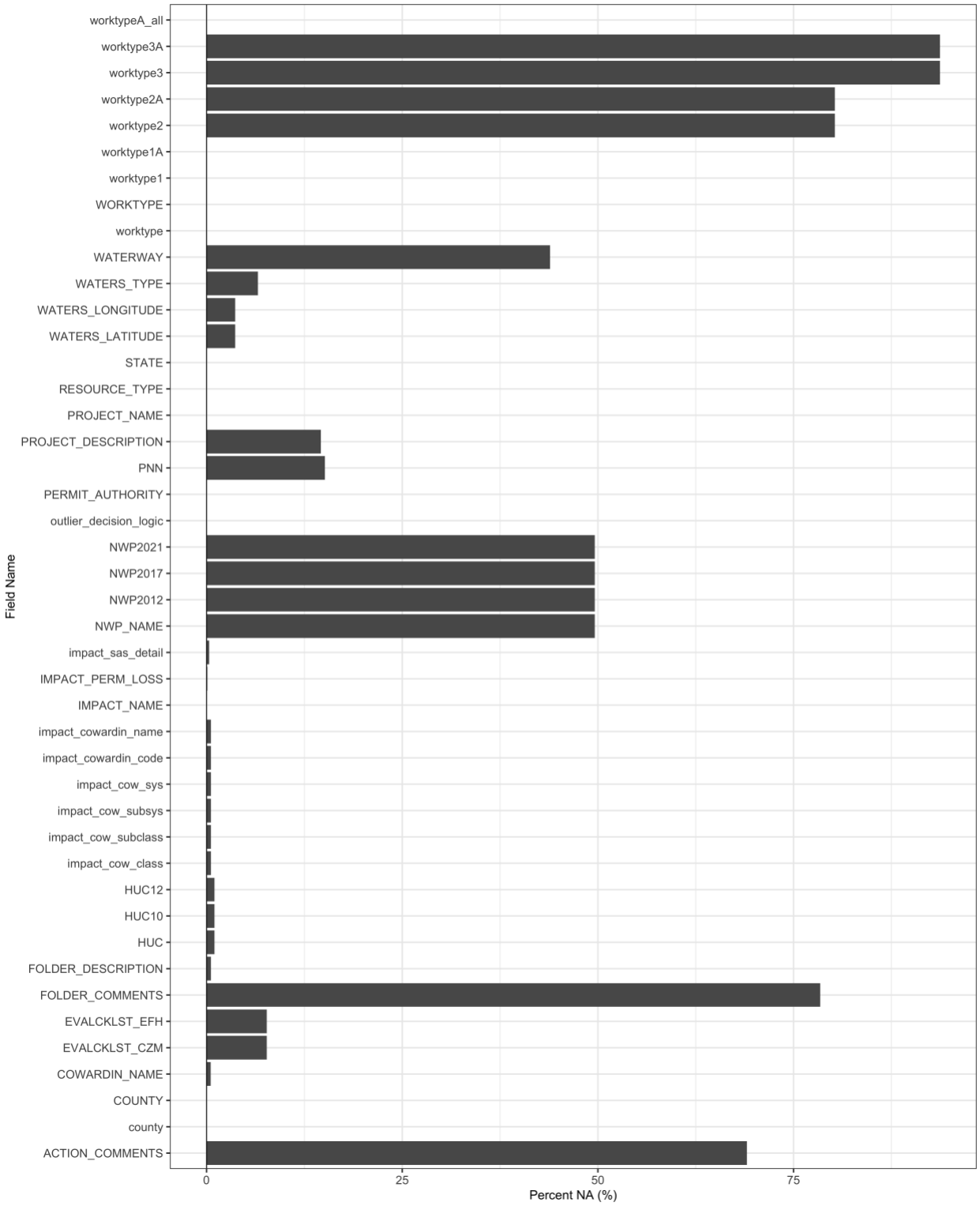

Figure 2-3: Percent (%) of records with NA values by field.Note that fields without NA values and the derived work type and Cowardin fields, which have the same number of NA values as the "WORKTYPE" and "COWARDIN_NAME" fields, are not shown for simplicity.

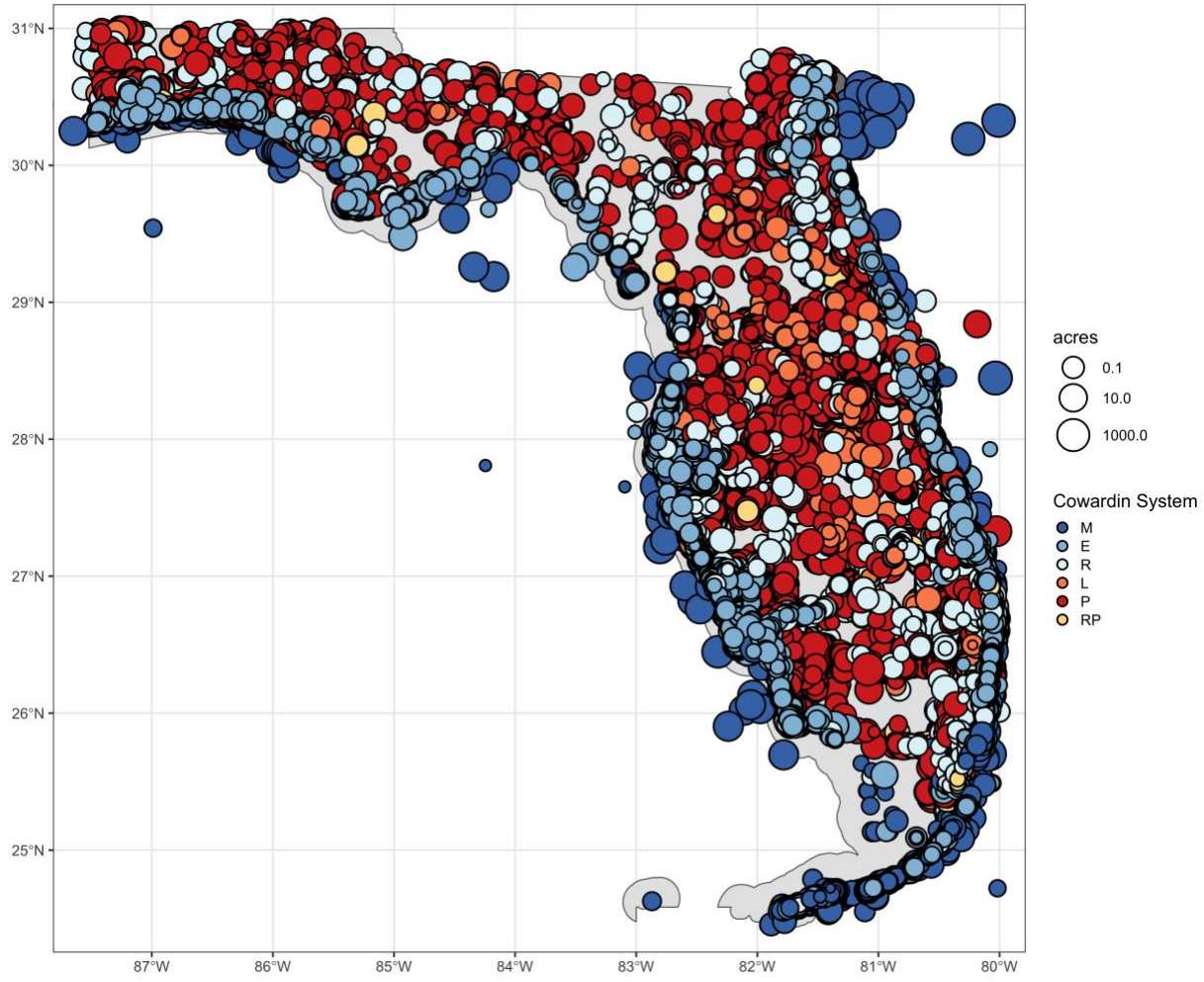

Figure 2-4: Map of impact data for state of Florida by Cowardin system and impact size. Illustrates the potential for the use of ORM2 data in geospatial analysis. The Cowardin codes are as follows: M = Marine, E = Estuarine, R = Riverine, L = Lacustrine, P = Palustrian, RP = Riparian. Coordinates are in the NAD83 datum.

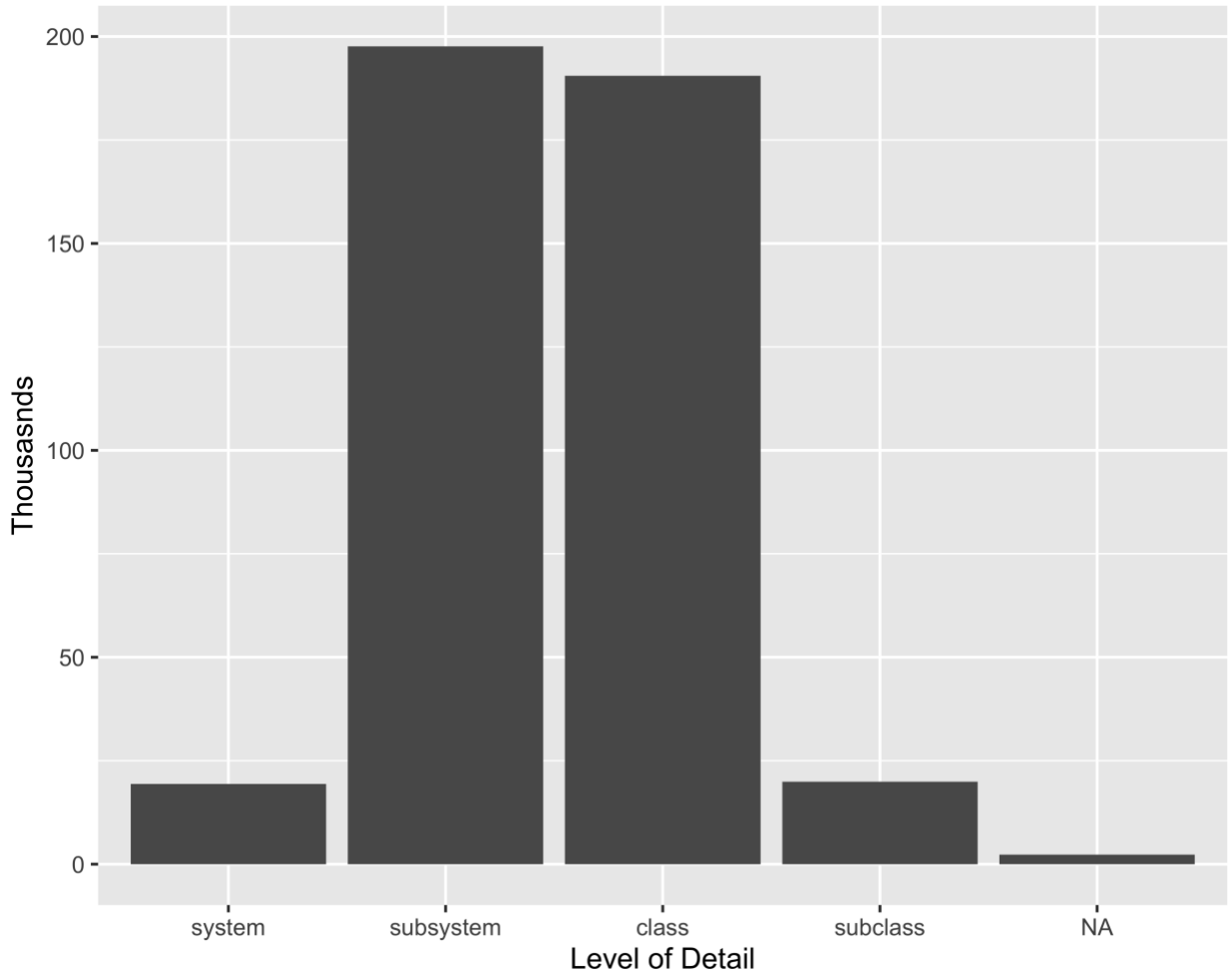

Figure 2-5: Comparison of the Cowardin classification system level of detail available in the "COWARDIN_NAME" and derived fields.

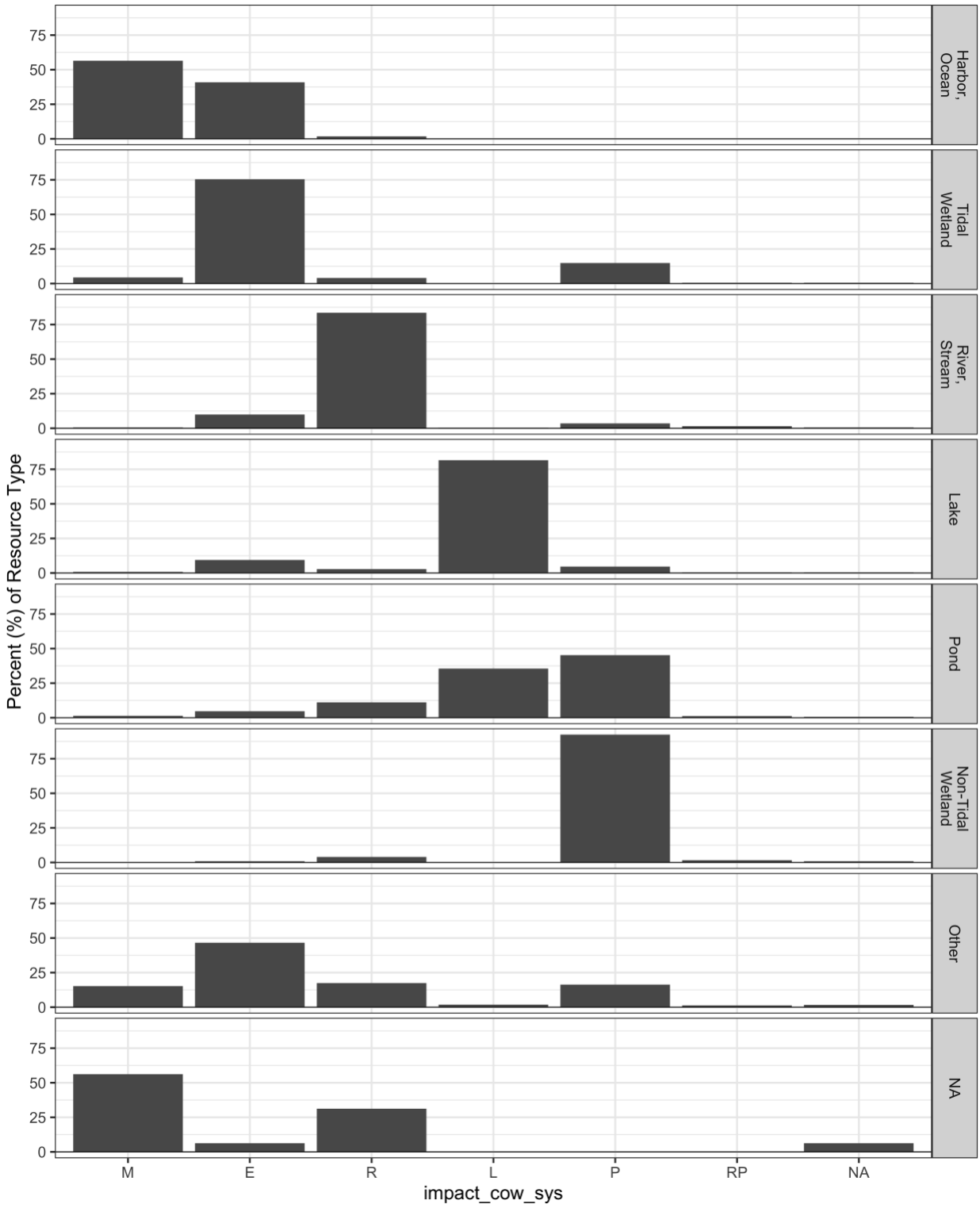

Figure 2-6: Comparison of two fields that describe the aquatic resource type: resource type and the Cowardin classification system("impact_cow_sys").

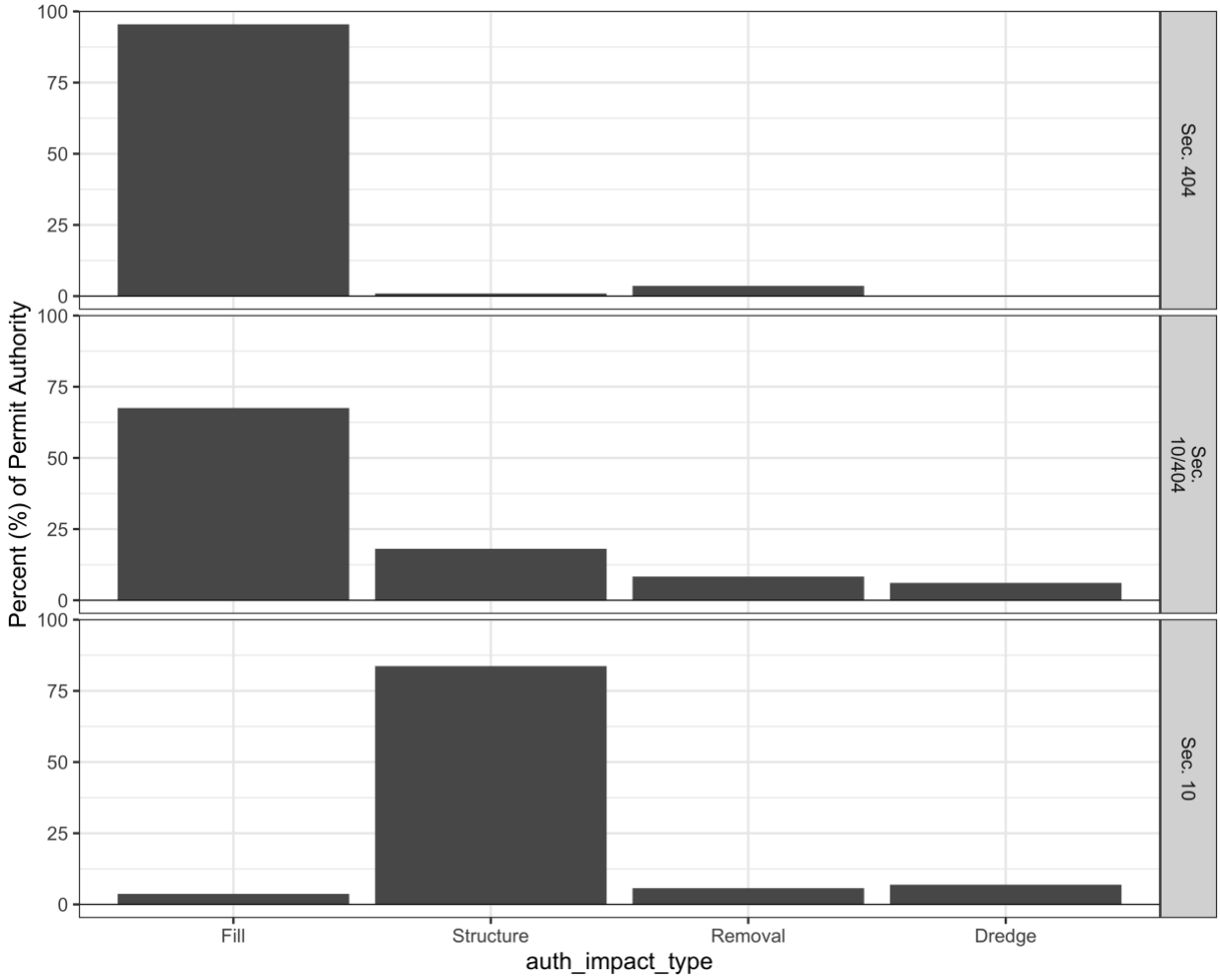

Figure 2-7: Comparison of two fields that describe the permit authority: permit authority and the impact type relative to the permit authority ("auth_impact_type").

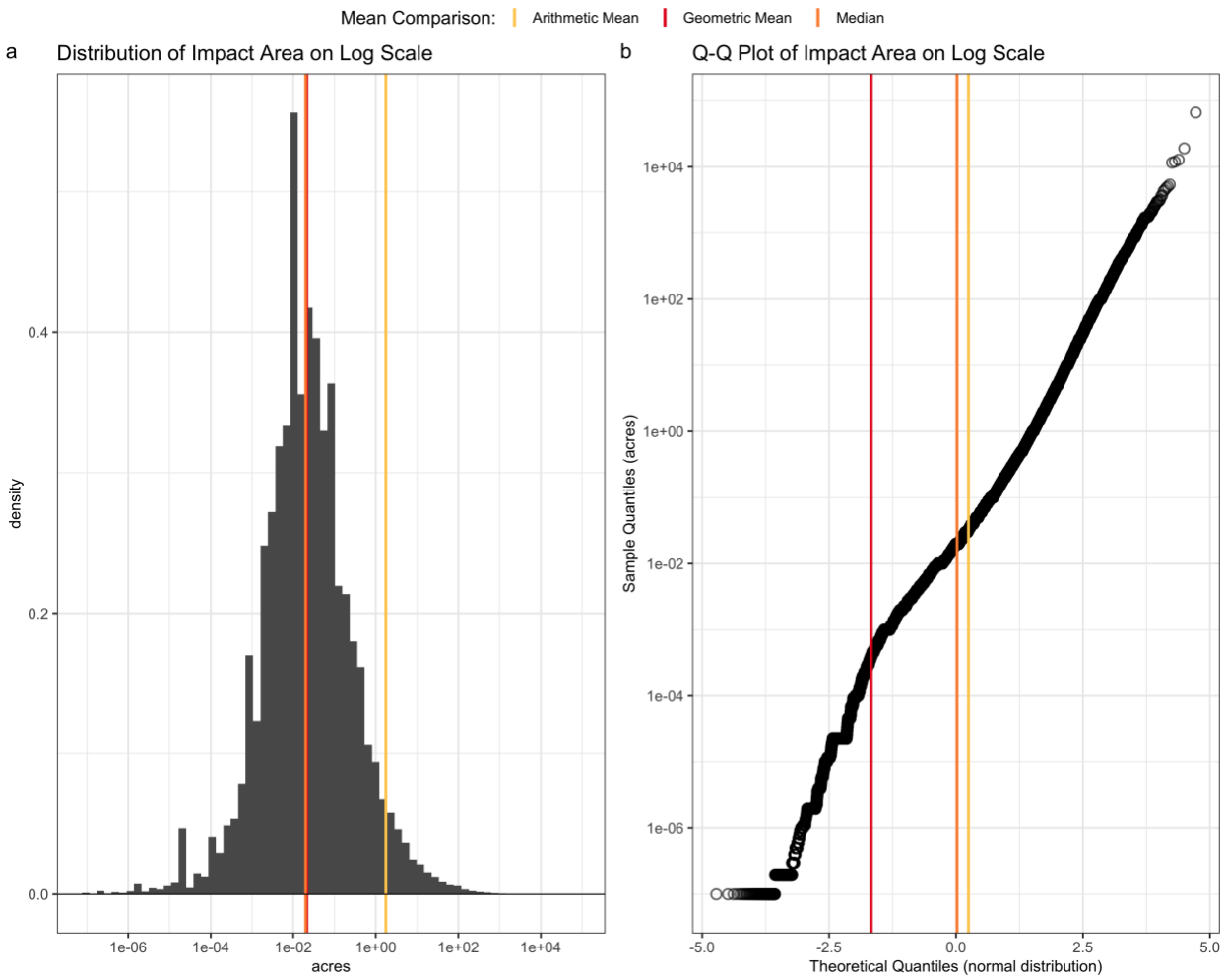

Figure 2-8: Frequency distribution of impact size (acres) in the final dataset. The arithmetic and geometric means of the ungrouped data are shown in light and dark orange, respectively. a) The central tendency (geometric mean) of impact area is small at 0.02 acres (0.0086 ha). b) Quantile-quantile plot comparing impact areas on the log scale with the normal distribution.

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Appendix 2-A: FOIA Request

FOIA-data-request-2023

Lia P. Flynn

2023-01-10

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January 10, 2023

USACE Head Quarters FOIA Requests C/O Humphreys Engineering Center Office of Council CEHEC-OC 7701 Telegraph Rd. Alexandria, VA 22315-3860 via email: ***foia@usace.army.mil***

Dear Humphreys Engineering Center Office of Council:

This is a request under the Freedom of Information Act (5 U.S.C. § 552).

I am requesting a digital copy (excel or csv file preferred) of the following documents: Operations & Maintenance Business Information Link Regulatory Module 2 (ORM2) records of permits issued or verified (with or without special conditions) that meet the below criteria:

- All the following fields: ACTION_FOLDER_ID, ACTION_ID, IMPACT_ID, MITIGATION_ID, DISTRICT, ORG_NAME, DA_NUMBER, ACTION, ACTION_TYPE, PERMIT_AUTHORITY, COMPENSATORY_MITIGATION_RQD, MITIGATION_PERMITTEE_RSP, PCN, WORKTYPE, PROJECT_NAME, FED_COMP_DATE, BEGIN_DATE, END_DATE, CLOSURE_METHOD, COUNTY, STATE, PROJ_LATITUDE, PROJ_LONGITUDE, IMPACT_NAME, IMPACT_DURATION, IMPACT_PERM_LOSS, IMPACT_TYPE, RESOURCE_TYPE, WATERS_NAME, WATERWAY, WATERS_TYPE, COWARDIN_NAME, WATERS_LATITUDE, WATERS_LONGITUDE, AUTH_LINEAR_FT, AUTH_FILL_LENGTH_FT, AUTH_FILL_WIDTH_FT, AUTH_FILL_ACRES, AUTH_FILL_VOL_CUFT, AUTH_REMVL_LENGTH_FT, AUTH_REMVL_WIDTH_FT, AUTH_REMVL_ACRES, AUTH_STRUC_LINEAR_FT, AUTH_STRUC_LENGTH_FT, AUTH_STRUC_WIDTH_FT, AUTH_STRUC_ACRES, AUTH_DRG_FILL_LENGTH_FT, AUTH_DRG_FILL_WIDTH_FT, AUTH_DRG_FILL_ACRES, AUTH_DRG_REMVL_LENGTH_FT, AUTH_DRG_REMVL_WIDTH_FT, AUTH_DRG_REMVL_ACRES, AUTH_DRG_REMVL_VOL_CUFT, MITIGATION_NAME, MITIGATION_TYPE, PERMITTEE_RESPONSIBLE_TYPE, MIT_RESOURCE_TYPE, MIT_WATERS_NAME, MIT_WATERWAY, MIT_WATERS_TYPE, MIT_COWARDIN_NAME, MIT_WATERS_AREA, MIT_WATERS_LINEAR, MIT_WATERS_LATITUDE, MIT_WATERS_LONGITUDE, MIT_REQ_LENGTH_FT, MIT_REQ_WIDTH_FT, MIT_REQ_ACRES, MIT_REQ_LINEAR_FT, CREDIT_UNIT, CREDITS_REQUIRED,

MBANK_ILF_PROGRAM_NAME, FOLDER_DESCRIPTION, PROJECT_DESCRIPTION, (applicant's) ORGANIZATION_NAME, FOLDER_COMMENTS, ACTION_COMMENTS, and whether or not EFH consultation or CZM consistency certification was required (from the Evaluation Checklist entry form).

- Authorized by one of the following Corps districts: NAE (New England District), NAN (New York District), NAP (Philadelphia District), NAB (Baltimore District), NAO (Norfolk District), SAW (Wilmington District), SAC (Charleston District), SAS (Savannah District), SAJ (Jacksonville District), SAM (Mobile District), MVK (Vicksburg District), MVN (New Orleans District), SWG (Galveston District), SPL (Los Angeles District), SPK (Sacramento District), SPN (San Francisco District), NWP (Portland District), NWS (Seattle District), POA (Alaska District), POH (Honolulu District).
- Has an end date between 1 January 2012 and 31 December 2022, inclusive.

For the purpose of assessing fees, I am affiliated with an educational institution and this request is made for a scholarly purpose and not for commercial use. I am not requesting duplication, so do not expect to pay a fee. If there will be a cost for processing this request, please inform me of the estimated charge first.

Please contact me by phone or email, if necessary, to discuss any aspect of my request.

Sincerely,

Lia Protopapadakis F. Doctoral Candidate,
UCLA Phone: 310-953-7149 Email:
lprotopapadakis@ucla.edu

Appendix 2-B: ORM2 FOIA Data Caveats

Thank you for your data request. The U.S. Army Corps of Engineers Regulatory (Regulatory) program is committed to making our data more transparent, accurate, and user friendly, but wish to provide the following caveats.

The Regulatory Program authorities include Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Federal Water Pollution Control Act, as amended in 1972 (commonly known as the Clean Water Act), and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972. Under these authorities, authorization is needed for work performed in, over or under navigable waters of the U.S.; for the discharge of dredged or fill material into waters of the U.S, including jurisdictional wetlands; and for the transportation of dredged for ocean disposal.

The Regulatory Program currently tracks application/permit data through the second version of a national database, OMBIL Regulatory Module (ORM2), beginning in June 2007. Prior to that, data was collected and stored at the district level to meet their specific requirements. Districts provided quarterly totals to Corps Headquarters, and the data were compiled and summarized on an annual basis. As districts began converting their historic data into the current version of the database, some districts had better success. As a result, data prior to mid 2007 are considered incomplete for many data elements.

Between 2007 and 2010 many database enhancements were made to ORM2 to improve the overall quality and completeness of the data. These changes were accompanied by user interface enhancements, additional documentation and training, and incorporation of database business and validation rules. Specific changes included adding additional fields for jurisdictional determinations in Feb 2008, making a nationwide permit number a mandatory field and not allowing permit stacking (allowing more than one permit number for the same action)) in Jun 2008, increasing granularity to impact and mitigation data in Jun 2009 (added fields for permanent and temporary impacts types and impact activity types), making additional data elements mandatory, and implementing rules to enforce improved data entry in Oct 2010, and adding a permanent loss field in Dec 2011. New reports and additional fields to existing reports were added to correspond with all the enhancements made over the years. Some of these enhanced reports are used for data quality control/quality assurance efforts. We continue to evaluate user suggestions, issue new policy and guidance, and make additional modifications to the ORM2 database. Additional documentation, training, and data quality assurance checks have led to more complete and consistent data entry practices. For these reasons, data prior to Oct 2010 should not be used for comparison purposes.

Our data can and do change over time. Every individual record has not been verified for accuracy and FOIA requests may receive data with errors (for example square feet were the intended units of impact, yet acres were accidently chosen). On a national level, data totals are analyzed for reasonableness and large data entry errors are reviewed and correction is requested by field project managers. Questions on individual projects should be referred to the districts.

We have worked closely with our staff to provide detailed information on the different types of impacts, and the data entry has shown the results of this finer level of detail, as well as the benefits of making this data entry mandatory in Oct 2010, resulting in more complete and accurate impact and mitigation data. There may be one or many permit actions under a permit number, and one or many impact and mitigation entries. There is generally one project location, with potentially many aquatic resources on larger sites which may be entered in the database. Impacts to and mitigation for those aquatic resources are then entered in the database. For projects with permanent impacts - When calculating impacts used in our overall no net loss reports, we only include certain impact activity types - discharge of dredged material, discharge of fill material, and the fill associated with excavation activities. If you have any questions on specific data elements, please check with your local Corps district.

Additional changes were made in conjunction with the 2017 Nationwide Permit issuance where some of the impact activity types have changed, text labels have been modified and a length/width **OR** area value is entered in the system. After Jun 2017, reports will provide only an area value for all impacts. The linear fields are available for data entered prior to this change in March 2017. In the future, reports will provide the area values only to avoid double counting errors. No additional changes are needed for the 2021 Nationwide Permit issuance.

Data in many reports are provided in a tree structure, with Actions, Impact and Mitigation data on separate rows. The output responsive to your FOIA request may contain the following data fields.

The first four columns may contain the unique ID number for the folder (Department of the Army (DA) number), action, impact, and mitigation entry. These values are helpful when working with DA numbers with multiple actions, impacts, and mitigation entries, often found with linear projects.

Actions:
DISTRICT – see attached list of abbreviations
DA_NUMBER - ORM2 tracking number
ACTION - Action, Impact or Mitigation entry (Impacts and Mitigation entries can be one to many)
ACTION_TYPE - Permit type - displays type of permit authorized. There are two categories and five types of permits that may be used by the Regulatory program. One category are the Individual permits that include Standard Permits (SP), which are generally more complex in nature and involve notification of the public and commenting agencies, and Letters of Permission (LOP), a type of permit issued through an abbreviated processing procedure which includes coordination with Federal and State fish and wildlife agencies, as required by the Fish and Wildlife Coordination Act, and a public interest evaluation, but without the publishing of an individual public notice. General permits (GP) are the second category of permits. GPs authorize activities that are similar in nature and cause only minimal adverse environmental impacts to aquatic resources, individually of on a cumulative basis. These permit types are issued every five years and individual requests are then verified to determine if they meet all the terms and conditions of the issued GP. There are three types of GPs: Nationwide permits (NWP) issued on a national basis used to streamline authorization of projects; Regional general permits (RGP) are issued for a specific geographic are by individual Corps districts; and Programmatic general permits (PGP), coordinated with local, state or other federal regulatory programs.
PNN - Nationwide or General Permit Number - e.g., NWP12 - utility line crossing
VERIFY TYPE – Used when reverifying a NWP previously verified under a different NWP issuance but original impacts has not changed (e.g., 2017 NWP, then verified again under the 2021 NWPs)
PERMIT_AUTHORITY - Permit authority used in permit verification/issuance
COMPENSATORY_MITIGATION_RQD - Indicates whether compensatory mitigation was required (generally not required for activities that don't involve fill (e.g., for structures like piers), temporary impacts, very small impacts (less than 1/10 Acre), etc)
MITIGATION_PERMITTEE_RSP – notes whether the permittees is responsible for the long term mitigation monitoring of the mitigation site. If a mitigation bank (bank) or in-lieu fee (ILF) program was used, changed in 2021 – responses are now all, some, or none to note projects where multiple compensatory mitigation types were used. If the project used permittee responsible AND a bank or ILF, the some option would be selected.
WORKTYPE – may enter one or up to three worktypes describing the work verified/authorized.
PROJECT NAME – the name of the project, may include additional information relating to the applicant, project purpose or other tracking numbers. Some Districts have standardized naming conventions and use abbreviations (i.e. ODOT – Oregon Department of Transportation)
END_DATE - permit action end date
CLOSURE_METHOD - how the project was issued/verified (with or without special conditions)

Project location data:

A project location is required, but may be entered as county, state, latitude/longitude, STR, or address. Most project managers generally enter a latitude/longitude (LL). For larger projects or projects with multiple actions, this is represented by a centroid.
COUNTY - Project county location
STATE - Project state location
HUC fields – 8, 10, and 12 digit Project hydrologic unit codes are provided
PROJ_LATITUDE - Project location information (county, state and HUC may be derived for LL entries)
PROJ_LONGITUDE - Project location information (county, state and HUC may be derived for LL entries)

Impacts: Data specific to impacts-

IMPACT_DURATION – indicates whether the impact is permanent or temporary

IMPACT_PERM_LOSS – indicates whether there is a permanent loss of the aquatic resource
IMPACT_TYPE - type of impact - we generally include only the discharge of dredged or fill material in our no net loss (NNL) estimates. Options include- discharge of dredged material, discharge of fill material, dredging, structure, work, other, fill associated with excavation, removal, conversion, ecological restoration, and Historic - data entered prior to addition of this field in 2009. Please note conversion and ecological restoration do not count as a "loss" in No Net Loss (NNL) computations. We also calculate NNL on a programmatic and not on an individual project basis.
WATERWAY - local waterway name (if a stream/river)
COWARDIN_CLASS - Cowardin Class of the Aquatic Resource entered
WATERS_LATITUDE - latitude of the Aquatic Resource
WATERS LONGITUDE - longitude of the Aquatic Resource
Each Impact Type has specific data entry fields – Linear feet/width or Acre values are related to the type of impact entered.
AUTH LINEAR_FT - fill linear foot (LF) value (this field is not used at a national level and may contain errors)
AUTH_FILL_LENGTH_Ft – for linear impacts, users would enter a length and width value
AUTH_FILL_WIDTH_Ft - for linear impacts, users would enter a length and width value
AUTH_FILL_ACRES – Amount of fill authorized by the project in Acres (Ac) – this is the only column used in NNL equations. Calculated by multiplying the Length and Width fields and dividing by 43560 (number of sq ft in an Acre) if a linear impact is entered.
AUTH_REMVL_LENGTH_Ft - for linear impacts, users would enter a length and width value
AUTH_REMVL_WIDTH_Ft– for linear impacts, users would enter a length and width value
AUTH_REMVL_ACRES - removal area (often contains errors and is not used on a national level)
AUTH_STRUC_LINEAR_FT - if a structure, LF of structure
AUTH_STRUC_LENGTH_Ft– for linear impacts, users would enter a length and width value
AUTH_STRUC_WIDTH_Ft– for linear impacts, users would enter a length and width value
AUTH_STRUC_ACRES - if a structure, area of structure. Calculated by multiplying the Length and Width fields and dividing by 43560 (number of sq ft in an Acre) if a linear impact is entered.
AUTH_DRG_FILL_LENGTH_Ft - for linear impacts, users would enter a length and width value
AUTH_DRG_FILL_WIDTH_Ft - for linear impacts, users would enter a length and width value
AUTH_DRG_FILL_ACRES - for dredging impact type, area in Ac. Calculated by multiplying the Length and Width fields and dividing by 43560 (sq ft in an Acre) if a linear impact is entered.
AUTH_DRG_REMVL_LENGTH_Ft– for linear impacts, users would enter a length and width value
AUTH_DRG_REMVL_WIDTH_Ft– for linear impacts, users would enter a length and width value
AUTH_DRG_REMVL_ACRES - for dredging impact type, area in Ac. Calculated by multiplying the Length and Width fields and dividing by 43560 (number of sq ft in an Acre) if a linear impact is entered.
AUTH_DRG_REMVL_VOL_CUFT - for dredging, fill volume in cubic feet

Mitigation Entries - required if the value of "Is Compensatory mitigation required" is YES.

MITIGATION_TYPE - type of mitigation used (if more than one type is used, more than one entry is added) – Permittee responsible mitigation (PRM), Bank or ILF
PERMITTEE_RESPONSIBLE_TYPE - captures mitigation methods used - establishment, re-establishment, enhancement, rehabilitation, preservation). Select the method for providing the compensatory mitigation. These terms are defined in the Mitigation Rule (33 CFR 332.2).
MIT_WATERS_LATITUDE – for PRM only if a separate aquatic resource was entered for the location of the site
MIT_WATERS_LONGITUDE -for PRM only if a separate aquatic resource was entered for the location of the site
Either an area or linear value needs to be entered for Mitigation Amount "Required" for Permittee Responsible Mitigation (PRM) or Credits for Banks/ILFs
MIT_REQ_LENGTH_Ft- for linear mitigation entries, users would enter a length and width value
MIT_REQ_WIDTH_Ft- for linear mitigation entries, users would enter a length and width value
MIT_REQ_ACRES - mitigation required in Ac
MIT_REQ_LINEAR_FT - mitigation required in LF
CREDIT_UNITS – type of credits, based on Acres, LF, assessment method outputs, or advanced credits.
CREDITS_REQUIRED - credits for banks may be dollars, Functional capacity units, Ac or LF
MIT BANK/ILF PROGRAM NAME – provided from Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS) - http://geo.usace.army.mil/ribits/index.html

Corps Headquarters has performed a cursory review of the impact and mitigation data from FY10 to the present. These data were not reviewed by the Districts for quality control/quality assurance purposes, although we ask that Districts review their data periodically. We have changed accounting procedures for impacts and mitigation data entry (most recently in Mar 2017, Dec 2011, Oct 2010 and Jun 2009) and legacy data (pre-ORM2 (Jun 2007) or prior to the database modifications) are not used by HQ when compiling data for comparison purposes.

Please note - there may be many NWPs per project (DA number) - especially in the case of linear projects, where each single and complete project (e.g. each crossing of a separate and distant waterbody) may receive a separate permit verification and separate data entry. Impacts and mitigation entries can also be one or many, depending on the types of impacts and aquatic resources in the project area, or when multiple mitigation sites (e.g. permittee responsible mitigation combined with mitigation bank credits) are used to provide compensatory mitigation for a particular NWP activity.

These data are also known to be incomplete due to legacy database conversion issues, incomplete data entry prior to when impact and mitigation data entry was made mandatory (Oct 2010) and data entry errors may also occur when entering impact and mitigation amounts and their units of measure (e.g. acres instead of linear feet or vice versa). Nationwide Permit number was not a mandatory field until late 2008, so some records may not contain this information.

We have made significant strides to ensure the accuracy and completeness of ORM2 data and continue to provide the most accurate information. Do note, subsequent requests for data, even from previous years, may yield varying results as data are often updated and corrected over time. Any questions regarding a specific entry or entries should be directed to the local Corps Regulatory district office.

District	Abbreviation
Alaska	POA
Albuquerque	SPA
Baltimore	NAB
Buffalo	LRB
Charleston	SAC
Chicago	LRC
Detroit	LRE
Ft Worth	SWF
Galveston	SWG
Honolulu	POH
Huntington	LRH
Jacksonville	SAJ
Kansas City	NWK
Little Rock	SWL
Los Angeles	SPL
Louisville	LRL
Memphis	MVM
Mobile	SAM
Nashville	LRN
New England	NAE
New Orleans	MVN
New York	NAN
Norfolk	NAO
Omaha	NWO
Philadelphia	NAP
Pittsburgh	LRP
Portland	NWP
Rock Island	MVR
Sacramento	SPK
San Francisco	SPN
Savannah	SAS
Seattle	NWS
St. Louis	MVS
St. Paul	MVP
Tulsa	SWT
Vicksburg	MVK
Walla Walla	NWW
Wilmington	SAW

Divisions

Great Lakes & River Division	LRD
Mississippi Valley Division	MVD
North Atlantic Division	NAD
South Atlantic Division	SAD
South Pacific Division	SPD
Southwestern Division	SWD
Pacific Ocean Division	POD
Northwestern Division	NWD

Appendix 2-C: Field Descriptions and Abbreviations in the Fields

Field Descriptions

ACRES

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Impact area in acres.
- Source: Comes from all authorized impact acre fields in raw data.
- Value: Open ended number in the range [0.0000001, 530233].
- Class: Numeric.

acres

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Impact area in acres (with outliers corrected).
- Source: Comes from all authorized impact acre fields after outliers were manually reviewed and corrected.
- Value: Open ended number in the range [0.0000001, 66240].
- Class: Numeric.

ACTION

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: System Generated.
- Description: USACE Regulatory action. Impact and Mitigation entries can be one to many.

- Source: Automatically populated based on the type of action being entered.
- Value: One of: Impact or Mitigation.
- Class: Character.

ACTION_COMMENTS

- Applicable dataset: Raw, clean.
- Type of field: Optional.
- Entry-type: Open Ended.
- Description: Comments added by the Project Manager to the action entry.
- Source: Entered by the Regulatory Project Manager in the permit action data form.
- Value: Open ended character string.
- Class: Character.

ACTION_FOLDER_ID

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Unique identifier for the permit action folder.
- Source: Automatically assigned when a new folder is created. A folder houses all the actions tracked in the database for a new request for a permit.
- Value: Range of: [825, 5361632].
- Class: Integer.

ACTION_ID

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Unique identifier for the action.
- Source: Automatically assigned when a new permit action is created.
- Value: Range of: [692273, 12186070].

- Class: Integer.

ACTION_TYPE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Type of permit authorized.
- Source: Selected from a menu in the folder window when entering data about a new permit action.
- Value: One of: LOP, NWP, PGP, RGP, or SP.
- Class: Character.

APPLICANT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Name of applicant (even for agencies or companies, this is the name of the point of contact).
- Source: Entered by the Regulatory Project Manager in the folder data form.
- Value: Open ended character string.
- Class: Character.

AUTH_DRG_FILL_ACRES

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) of aquatic resource impacted by the discharge of dredged material.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Dredging prior to 2018.
- Value: Open ended number.

- Class: Numeric.

AUTH_DRG_REMVL_ACRES

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) to be dredged.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Dredging.
- Value: Open ended number.
- Class: Numeric.

AUTH_DRG_REMVL_LENGTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of aquatic resource to be dredged. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Dredging.
- Value: Open ended number.
- Class: Numeric.

AUTH_DRG_REMVL_VOL_CUFT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Volume (cubic feet) of material to be removed from dredge site.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Dredging.
- Value: Open ended number.

- Class: Numeric.

AUTH_DRG_REMVL_WIDTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Width (feet) of aquatic resource to be dredged. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Dredging.
- Value: Open ended number.
- Class: Numeric.

AUTH_FILL_ACRES

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) of aquatic resource impacted by fill material.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Conversion of waters type, Discharge of fill material, Discharge of dredged material, Ecological Restoration, Other, Work, Excavation associated with the discharge of dredged or fill material, and prior to 2017, Transport of dredged material.
- Value: Open ended number.
- Class: Numeric.

AUTH_FILL_LENGTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.

- Description: Length (feet) of aquatic resource impacted by fill material. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Conversion of waters type, Discharge of fill material, Discharge of dredged material, Ecological Restoration, Other, Work, Excavation associated with the discharge of dredged or fill material, and prior to 2017, Transport of dredged material.
- Value: Open ended number.
- Class: Numeric.

AUTH_FILL_VOL_CUFT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Volume (cubic feet) of material to be placed as fill.
- Source: Transport of dredged material (Sec 103).
- Value: Open ended number.
- Class: Numeric.

AUTH_FILL_WIDTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Width (feet) of aquatic resource impacted by fill material. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Conversion of waters type, Discharge of fill material, Discharge of dredged material, Ecological Restoration, Other, Work, Excavation associated with the discharge of dredged or fill material, and prior to 2017, Transport of dredged material.
- Value: Open ended number.
- Class: Numeric.

auth_impact_type

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Authorized impact type.
- Source: Comes from the field name where the impact amount was stored.
- Value: One of: Dredge, Fill, Removal, or Structure.
- Class: Character.

AUTH_LINEAR_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of aquatic resource impacted by jurisdictional activity (for linear features, e.g., a stream; or linear impacts, e.g., bank stabilization). Not used after 2017 but may show up in later data due to reverifications or permit modifications that do not modify the impact entries.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Conversion of waters type, Discharge of fill material, Discharge of dredged material, Ecological Restoration, Transport of dredged material, Other, Work, Excavation associated with the discharge of dredged or fill material.
- Value: Open ended number.
- Class: Numeric.

AUTH_REMVL_ACRES

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) of aquatic resource impacted by the removal of dredged or fill material.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Removal, Other, Excavation associated with the discharge

of dredged or fill material, Work, Conversion of waters type (prior to 2018), Ecological restoration (prior to 2018), and Transport of dredged material (prior to 2017).

- Value: Open ended number.
- Class: Numeric.

AUTH_REMVL_LENGTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of aquatic resource impacted by the removal of dredged or fill material. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Removal, Other, Excavation associated with the discharge of dredged or fill material, Work, Conversion of waters type (prior to 2018), Ecological restoration (prior to 2018), and Transport of dredged material (prior to 2017).
- Value: Open ended number.
- Class: Numeric.

AUTH_REMVL_WIDTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Width (feet) of aquatic resource impacted by the removal of dredged or fill material. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Removal, Other, Excavation associated with the discharge of dredged or fill material, Work, Conversion of waters type (prior to 2018), Ecological restoration (prior to 2018), and Transport of dredged material (prior to 2017).
- Value: Open ended number.
- Class: Numeric.

AUTH_STRUC_ACRES

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) of aquatic resource impacted by a structure.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Structure and Other.
- Value: Open ended number.
- Class: Numeric.

AUTH_STRUC_LENGTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of aquatic resource impacted by a structure. Not used after 2017 but may show up in later data due to reverifications or permit modifications that don't modify the impact entries.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Structure and Other.
- Value: Open ended number.
- Class: Numeric.

AUTH_STRUC_LINEAR_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of aquatic resource impacted by a structure.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Structure and Other.
- Value: Open ended number.
- Class: Numeric.

AUTH_STRUC_WIDTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Width (feet) of aquatic resource impacted by a structure. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the impact data form. Available for the following impact type: Structure and Other.
- Value: Open ended number.
- Class: Numeric.

BEGIN_DATE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Date USACE received the request for a permit.
- Source: Automatically populated based on the date the folder is created, but can be manually adjusted by the Regulatory Project Manager.
- Value: In form YYYY-MM-DD. Range of: [1975-05-08, 2050-08-01].
- Class: Date.

change_made

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Was the impact size changed because of the outlier analysis.
- Source: Descriptions that supported a unit conversion, some other change, or did not support the impact size were changed. Descriptions that confirmed, supported, or did not contradict the impact size, were not changed.
- Value: One of: FALSE, or TRUE.
- Class: Logical.

CLOSURE_METHOD

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: USACE's permit decision
- Source: Selected from a menu when entering data in the permit action data form.
- Value: One of: Complete, Exceeded Corps Review Time Limit, Verified By Default, Issued With Special Conditions, Issued Without Special Conditions, Verified With Special Conditions, or Verified Without Special Conditions.
- Class: Character.

coastal

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Is the county a coastal county?
- Source: Data on coastal counties come from NOAA Office of Coastal Management. Refer to description of "coastal.counties.lookup" in the "ORMimportr" package.
- Value: One of: FALSE, or TRUE.
- Class: Logical.

comp_mit_rqd

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Is compensatory mitigation required to offset unavoidable losses to aquatic resource functions?
- Source: Corrected version of "COMPENSATORY_MITIGATION_RQD" in which "No" values were converted to "Yes" if the "ACTION_ID" has a corresponding mitigation entry.
- Value: One of: No, or Yes.

- Class: Character.

COMPENSATORY_MITIGATION_RQD

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Is compensatory mitigation required as a special condition to the permit?
- Source: Selected from a menu when entering data in the permit action data form.
- Value: One of: No, Yes, or NA.
- Class: Character.

COUNTY

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: County where the proposed activity would occur.
- Source: Automatically populated based on the coordinates of the project site, or can be manually entered.
- Value: USGS county name. 1024 unique values. E.g., North Slope Borough, Ouachita Parish, or Otsego County.
- Class: Character.

county

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Name of the County where the proposed activity would occur.
- Source: Manually corrected value based on authorizing USACE District.
- Value: One of 1024 USPS accepted county names followed by the terms “Borough”, “Census Area”, “City”, “County”, “District”, “Island”, “Municipality”, “Municipio”, “Parish” as appropriate. E.g., Ketchikan Gateway Borough, Ouachita Parish, or Otsego County.

- Class: Character.

COWARDIN_NAME

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Cowardin classification code and name of the aquatic resource at the impact site. May also be under the field name “COWARDIN_CLASS.” E.g., Refer to Cowardin (1979).
- Source: Selected from a menu on the aquatic resource data form.
- Value: 306 unique values consisting of the Cowardin code a space-dash-space (” - “) and the Cowardin code description. E.g.,”E2AB1 - Estuarine, Intertidal, Aquatic Bed, Algae”.
- Class: Character.

CREDIT_UNIT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Value of the credit.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: One of: Acre Based, Advanced Credit, Assessment Based, Linear Feet Based, or NA.
- Class: Character.

CREDITS_REQUIRED

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Number of credits required for compensatory mitigation.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended number.

- Class: Numeric.

DA_NUMBER

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Unique identifier for the project folder.
- Source: Automatically assigned when a new folder is created. This is the permit number.
- Value: Of the form: AAA-YYYY-XXXXX-BBB, where AAA is the 3-letter district code, YYYY is the 4-digit year the folder was created, XXXXX is a unique identifier automatically assigned by ORM2, and BBB is an optional three-letter initials of the Regulatory Project Manager (e.g., SWG-2023-00099, SWG-2023-00096, or SWG-2023-00085).
- Class: Character.

DISTRICT

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: USACE district code.
- Source: Automatically populated based on the district originating the folder.
- Value: Three-letter code for the USACE District. One of: MVK, MVN, NAB, NAE, NAN, NAO, NAP, NWP, NWS, POA, POH, SAC, SAJ, SAM, SAS, SAW, SPK, SPL, SPN, or SWG.
- Class: Character.

district

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Three-letter code of USACE District arranged clockwise from New England to Alaska and Hawaii.
- Source: Added from “usace.lookup” table based on the “DISTRICT” field.

- Value: One of 20: NAE, NAN, NAP, NAB, NAO, SAW, SAC, SAS, SAJ, SAM, MVK, MVN, SWG, SPL, SPK, SPN, NWP, NWS, POA, or POH.
- Class: Factor.

district_name

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Full name of USACE District which authorized the impact.
- Source: Added from the “usace.lookup” table and linked with the “DISTRICT” field.
- Value: One of 20: New England District, New York District, Philadelphia District, Baltimore District, Norfolk District, Wilmington District, Charleston District, Savannah District, Jacksonville District, Mobile District, Vicksburg District, New Orleans District, Galveston District, Los Angeles District, Sacramento District, San Francisco District, Portland District, Seattle District, Alaska District, or Honolulu District.
- Class: Factor.

division

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Three-letter code of the USACE Division.
- Source: Added from the “usace.lookup” table.
- Value: One of 7: NAD, SAD, MVD, SWD, SPD, NWD, or POD.
- Class: Factor.

division_name

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Full name of USACE Division in which the impact was authorized.

- Source: Added from the “usace.lookup” table and linked with the “DISTRICT” and “STATE” fields.
- Value: On of 7: North Atlantic Division, South Atlantic Division, Mississippi Valley Division, Southwestern Division, South Pacific Division, Northwestern Division, or Pacific Ocean Division.
- Class: Factor.

END_DATE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Date USACE transmitted a permit decision.
- Source: Entered by the Regulatory Project Manager in the permit action data form.
- Value: In form YYYY-MM-DD. Range of: [2012-01-02, 2022-12-31]
- Class: Date.

end_year

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Year permit authorized.
- Source: Extracted from “END_DATE”.
- Value: 4-digit year [2012, 2022].
- Class: Numeric.

EVALCKLST_CZM

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Did the action require Coastal Zone Management consistency certification.
- Source: Selected from a menu in the Evaluation Checklist data form.

- Value: One of: Not Required, Required, or NA.
- Class: Character.

EVALCKLST_EFH

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Did the action require EFH consultation.
- Source: Selected from a menu in the Evaluation Checklist data form.
- Value: One of: No Resources Present, Resources Present/Consultation Required, Resources Present/No Effect, or NA.
- Class: Character.

FED_COMP_DATE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Date the request for a permit was considered complete per USACE regulations.
- Source: Entered by the Regulatory Project Manager in the completeness determination data form.
- Value: In form YYYY-MM-DD. Range of: [1975-06-20, 2022-12-31].
- Class: Date.

FOLDER_COMMENTS

- Applicable dataset: Raw, clean.
- Type of field: Optional.
- Entry-type: Open Ended.
- Description: Comments added by the Project Manager to the project folder.
- Source: Entered by the Regulatory Project Manager in the folder data form.
- Value: Open ended character string.

- Class: Character.

FOLDER_DESCRIPTION

- Applicable dataset: Raw, clean.
- Type of field: Optional.
- Entry-type: Open Ended.
- Description: Description of project supplied by applicant.
- Source: Entered by the Regulatory Project Manager in the folder data form.
- Value: Open ended character string.
- Class: Character.

geo_decision_logic

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Description of results of manual check of geographic information.
- Source: Created during manual check of mis-matched Corps districts and state/county entries.
- Value: One of: Based on other fields in data, or Not flagged for review.
- Class: Character.

GNIS_WATERWAY

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Nearest named waterbody to where the proposed activity would occur (based on coordinates, which can default to the county midpoint).
- Source: Automatically populated based on the coordinates of the project site.
- Value: USGS Waterway names. 13969 unique values. E.g., Ouachita River, Macon, Bayou, or Jones Creek.
- Class: Character.

HUC

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: 8-digit HUC watershed code in which the proposed activity would occur (based on coordinates, which can default to the county midpoint).
- Source: Automatically populated based on the coordinates of the project site.
- Value: 8-digit Hydrologic Unit Code.
- Class: Character.

HUC10

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: 10-digit HUC watershed code in which the proposed activity would occur (based on coordinates, which can default to the county midpoint).
- Source: Automatically populated based on the coordinates of the project site.
- Value: 10-digit Hydrologic Unit Code.
- Class: Character.

HUC12

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: 12-digit HUC watershed code in which the proposed activity would occur (based on coordinates, which can default to the county midpoint).
- Source: Automatically populated based on the coordinates of the project site.
- Value: 12-digit Hydrologic Unit Code.
- Class: Character.

impact_cow_class

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: System, subsystem, and class levels of the Cowardin classification code.
- Source: Extracted from “impact_cowardin_code” which comes from “COWARDIN_NAME”. Refer to Cowardin (1979) for details.
- Value: One of 93 unique options in the form “A(A)XBB” where A is the 1- or 2-letter system code, X is the 1-digit subsystem code, and BB is the 2-letter class code: E1AB, M1AB, R1AB.
- Class: Character.

impact_cow_subclass

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: System, subsystem, class, subclass levels of the Cowardin classification code.
- Source: Extracted from “impact_cowardin_code” which comes from “COWARDIN_NAME”. Refer to Cowardin (1979) for details.
- Value: One of 298 unique options of the form A(A)XBB(Y), where A is the 1- or 2-letter “system” code, X is the 1-digit subsystem code, BB is the 2-letter class code, and Y is the 1-digit subclass code: E1AB1, M1AB1, R1AB1.
- Class: Character.

impact_cow_subsys

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: System and subsystem levels of the Cowardin classification code.
- Source: Extracted from “impact_cowardin_code” which comes from “COWARDIN_NAME”. Refer to Cowardin (1979) for details.

- Value: One of 22 unique options in the form “A(A)X” where A is the 1- or 2-letter system code and X is the 1-digit subsystem code: E, E1, E2, L, L1, L2, M, M1, M2, P, R, R1, R2, R3, R4, R5, R6, RP, RP1, RP2, U, or NA.
- Class: Character.

impact_cow_sys

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: System level of the Cowardin classification code.
- Source: Extracted from “impact_cowardin_code” which comes from “COWARDIN_NAME”, where E = Estuarine, L = Lacustrine, M = Marine, P = Palustrine, R = Riverine, and RP = Riparian. Refer to Cowardin (1979) for details.
- Value: One of: E, L, M, P, R, RP, U, or NA.
- Class: Character.

impact_cowardin_code

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Cowardin classification code of the impacted waters.
- Source: Extracted from “COWARDIN_NAME”.
- Value: One of 298 unique options of the form A(A)XBB(Y), where A is the 1- or 2-letter ‘system’ code, X is the 1-digit subsystem code, BB is the 2-letter class code, and Y is the 1-digit subclass code. E.g., E2US3, M2US4, R6. Refer to Cowardin (1979) for details.
- Class: Character.

impact_cowardin_name

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Description of the Cowardin classification code of the impacted waters.

- Source: Added from a lookup table and linked with the “impact_cowardin_code” field.
- Value: One of 129 unique options. E.g., Estuarine, Intertidal, Unconsolidated Shore; Marine, Intertidal, Unconsolidated Shore; Riverine, Ephemeral (Unique to the Corps). Refer to Cowardin (1979) for details.
- Class: Character.

IMPACT_DURATION

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Duration of the proposed impact. Temporary impacts are typically construction-related and either expected to recover naturally or required to be restored after construction is complete. Permanent impacts persist after construction is complete.
- Source: Selected from a menu when entering data in the impact data form.
- Value: One of: Permanent, Temporary, or NA.
- Class: Character.

IMPACT_ID

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Unique identifier for the impact entry (non-impact entries, such as mitigation, have a null value).
- Source: Automatically assigned when a new impact is entered.
- Value: Range of: [60807, 2740587].
- Class: Numeric.

impact_id

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.

- Description: Unique identifier for impact entries that had more than one authorized impact amount.
- Source: Based on “IMPACT_ID” with a sub-ID number indicating when action was associated with more than one impact.
- Value: Of the form “IMPACT_ID-X”, where X is a unique positive integer. E.g., 1463716-1, 1480031-1, 1480031-2.
- Class: Character.

IMPACT_NAME

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Name of the proposed impact.
- Source: Entered by the Regulatory Project Manager in the impact data form.
- Value: Open ended character string.
- Class: Character.

IMPACT_PERM_LOSS

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Would the impact result in a permanent loss of waters of the U.S./wetlands? A loss means the activity would permanently remove the aquatic resource from USACE jurisdiction.
- Source: Selected from a menu when entering data in the impact data form.
- Value: One of: N, Y, or NA.
- Class: Character.

impact_sas_detail

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.

- Description: Type of Special Aquatic Site (SAS) based on Cowardin code of impact site.
- Source: Created from “impact_cowardin_code” which comes from “COWARDIN_NAME”.
- Value: One of: Coral, Mudflat, Not SAS, SAV, Wetland, or NA.
- Class: Character.

IMPACT_TYPE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: The type of impact as it relates to USACE permit authority.
- Source: Selected from a menu when entering data in the impact data form.
- Value: One of: Conversion of waters type (forested wetland to emergent wetland, stream to lake), Discharge of dredged material, Discharge of fill material, Dredging (Section 10), Ecological restoration, Excavation associated with the discharge of dredged or fill material, Historical Undertermined [sic], Other (Aquaculture, Work, Aerial or Submarine cable crossings), Removal (Sec 10 structures), Structure (Sec 10 only), Transport of dredged material (Sec 103), Work (non-fill, Section 10), or NA.
- Class: Character.

impact_type

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Shorthand version of impact_type.
- Source: Refer to “IMPACT_TYPE” description for more detail.
- Value: One of: Conversion of waters type, Discharge of dredged material, Discharge of fill material, Dredging, Ecological restoration, Excavation, Other/Work, Removing structure, Structure, or Transport of dredged material.
- Class: Character.

MBANK_ILF_PROGRAM_NAME

- Applicable dataset: Raw.

- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Name of the Mitigation Bank or In-Lieu Fee program.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended character string.
- Class: Character.

MIT_COWARDIN_NAME

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Cowardin classification code and name of the aquatic resource at the mitigation site. Refer to Cowardin (1979).
- Source: Selected from a menu in the aquatic resources data form.
- Value: 185 unique values consisting of the Cowardin code a space-dash-space (" - ") and the Cowardin code description. E.g.,"E2AB1 - Estuarine, Intertidal, Aquatic Bed, Algae".
- Class: Character.

MIT_REQ_ACRES

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) of required compensatory mitigation.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended number.
- Class: Numeric.

MIT_REQ_LENGTH_FT

- Applicable dataset: Raw.
- Type of field: Required.

- Entry-type: Open Ended.
- Description: Length (feet) of required compensatory mitigation. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended number.
- Class: Numeric.

MIT_REQ_LINEAR_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of required compensatory mitigation. Not used after 2017 but may show up in later data due to reverifications or permit modifications that don't modify the impact entries.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended number.
- Class: Numeric.

MIT_REQ_WIDTH_FT

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Width (feet) of required compensatory mitigation. Length/width only required if acres not provided. If length provided, both length and width are required, and area is calculated.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended number.
- Class: Numeric.

MIT_RESOURCE_TYPE

- Applicable dataset: Raw.

- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Type of aquatic resource at the mitigation site (before mitigation).
- Source: Selected from a menu in the mitigation data form.
- Value: One of: Harbor/Ocean, Lake, Non-Tidal Wetland, Other, Pond, River/Stream, Tidal Wetland, or NA.
- Class: Character.

MIT_WATERS_AREA

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Area (acres) of jurisdictional waters within the review area at the mitigation site (not the required area for compensatory mitigation).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended number.
- Class: Numeric.

MIT_WATERS_LATITUDE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Latitude of the midpoint of the review area at the mitigation site. Projection is NAD83, EPSG:4269. (If not specified by the Regulatory Project Manager it defaults to the IMPACT_LATITUDE, which defaults to the county midpoint).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended number.
- Class: Numeric.

MIT_WATERS_LINEAR

- Applicable dataset: Raw.

- Type of field: Required.
- Entry-type: Open Ended.
- Description: Length (feet) of jurisdictional waters within the review area at the mitigation site (not the required area for compensatory mitigation). Not used after 2017, but may show up in later data due to reverifications or permit modifications that do not modify the impact entries.
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended number.
- Class: Numeric.

MIT_WATERS_LONGITUDE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Longitude of the midpoint of the review area at the mitigation site. Projection is NAD83, EPSG:4269. (If not specified by the Regulatory Project Manager it defaults to the IMPACT_LATITUDE, which defaults to the county midpoint).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended number.
- Class: Numeric.

MIT_WATERS_NAME

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Name of the aquatic resource at the mitigation site.
- Source: Entered by the Regulatory Project Manager in the aquatic resources data form.
- Value: Open ended character string.
- Class: Character.

MIT_WATERS_TYPE

- Applicable dataset: Raw.

- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Type of waters as defined in regulation. Changes with changing definition of waters of the U.S.
- Source: Selected from a menu in the aquatic resources data form.
- Value: One of: A1, A1-1.TNW-404.10, A1TNW10, A1TNWFED, A2B, A2O, A2TRIBINT, A2TRIBPER, A3, A3LPIFLOW, A4, A4WETABUT, A4WETARTSEP, A4WETFLOOD, A4WETNATSEP, A5, A6BOHWM, A6BWB, A6N1WB, A6N2WB, A6N3HWB, A8HWB, A8OOHWM, A8OWB, B1WETNONADJ, B5DITCH, DELINC, DELINEATE, DELINPJD, DRYLAND, EXCLDB3I, IMPNDMNT, ISOLATE, NOJD10404, NOJD404, NRPW, NRPWW, PJD10404, PJD404, RHA10NAV, RHATIDAL, RPW, RPWWD, RPWWN, TNW, TNWRPW, TNWW, UPLAND, or NA.
- Class: Character.

MIT_WATERWAY

- Applicable dataset: Raw.
- Type of field: Optional.
- Entry-type: Open Ended.
- Description: Name of the nearest named waterbody to the mitigation site.
- Source: Entered by the Regulatory Project Manager in the aquatic resources data form.
- Value: Open ended character string.
- Class: Character.

MITIGATION_ID

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Unique identifier for the mitigation entry (non-mitigation entries, such as impacts, have null values).
- Source: Automatically assigned when new mitigation is entered.
- Value: Range of: [60645, 365565].
- Class: Numeric.

MITIGATION_NAME

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Name of the proposed mitigation.
- Source: Entered by the Regulatory Project Manager in the mitigation data form.
- Value: Open ended character string.
- Class: Character.

MITIGATION_PERMITTEE_RSP

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Is the compensatory mitigation permittee responsible?
- Source: Selected from a menu when entering data in the permit action data form.
- Value: One of: All, None, Some, or NA.
- Class: Character.

MITIGATION_TYPE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Type of mitigation proposed.
- Source: Selected from a menu in the mitigation data form.
- Value: One of: Advanced Permittee Responsible, In-Lieu Fee, Mitigation Bank, Permittee Responsible (off-site), Permittee Responsible (on-site), or NA.
- Class: Character.

NWP2012

- Applicable dataset: Clean.

- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Was the permit issued in 2012?
- Source: Added from the “nwp.lookup” lookup table.
- Value: One of: FALSE, TRUE, or NA.
- Class: Logical.

NWP2017

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Was the permit issued in 2017?
- Source: Added from the “nwp.lookup” lookup table.
- Value: One of: FALSE, TRUE, or NA.
- Class: Logical.

NWP2021

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Was the permit issued in 2021?
- Source: Added from the “nwp.lookup” lookup table.
- Value: One of: FALSE, TRUE, or NA.
- Class: Logical.

NWP_NAME

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.

- Description: Name of the Nationwide Permit.
- Source: Added from the “nwp.lookup” lookup table.
- Value: One of 58 unique options. E.g., Agriculture Activities, Aids to Navigation, or Approved Categorical Exclusions.
- Class: Character.

ORG_NAME

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: System Generated.
- Description: Name of organizational sub-unit within the USACE District.
- Source: Automatically populated based on the organizational unit originating the folder.
- Value: One of 127 unique values. E.g., Alaska District, Anchorage Section, or Antilles Section (North Branch).
- Class: Character.

outlier_decision_logic

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Confidence rating of impact size.
- Source: Created during manual check of potential outliers. Only impact areas greater than the 99.9^{th} percentile of all impacts in that category were reviewed.
- Value: One of: Description confirms impact size, Description supports impact size, Description supports unit conversion, Description supports other change, Description does not contradict impact size, Not flagged for review, or NA.
- Class: Factor.

PCN

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.

- Description: For activities that qualify for a General Permit, was a preconstruction notification required?
- Source: Selected from a menu when entering data in the permit action data form. Only applies to General Permits.
- Value: One of: N, Y, or NA.
- Class: Character.

PERMIT_AUTHORITY

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Authority under which the activity is regulated.
- Source: Selected from a menu when entering data in the permit action data form.
- Value: One of: Historical, Section 10, Section 10/404, Section 13, or Section 404.
- Class: Character.

permit_authority

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Authority for regulating the specified impact.
- Source: Based on “PERMIT_AUTHORITY” field, will some missing values filled in based on “auth_impact_type” and “RESOURCE_TYPE” fields.
- Value: One of: Sec. 10, Sec. 10/404, Sec. 13, Sec. 404.
- Class: Character.

permit_type

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Consolidated action type.

- Source: Created from ACTION_TYPE, but consolidates nationwide permits (NWP), regional general permits (RGP), and programmatic general permits (PGP) into one general permit (GP) category. Letters of permission (LOP) and standard permits (SP) were not changed.
- Value: One of: GP, LOP, or SP.
- Class: Character.

PERMITTEE_RESPONSIBLE_TYPE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Type of mitigation action proposed.
- Source: Selected from a menu in the mitigation data form.
- Value: One of: Bank/ILF, Enhancement, Establishment, Preservation, Re-establishment, Rehabilitation, or NA.
- Class: Character.

PNN

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Identification number for General Permits.
- Source: Selected from a menu when entering data in the permit action data form.
- Value: The number given to the General Permit by the issuing office and as published in the federal register (nationwide permits) or through public notice by the USACE District. E.g., NWP 27, PGP-60, or RGP-33.
- Class: Character.

PROJ_LATITUDE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.

- Description: Latitude of location of the proposed activity. Projection is NAD83, EPSG:4269. (If not specified by the Regulatory Project Manager it defaults to the county midpoint).
- Source: Automatically populated based on the coordinates of the project site.
- Value: Decimal degrees.
- Class: Numeric.

PROJ_LONGITUDE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Longitude of the location of the proposed activity. Projection is NAD83, EPSG:4269. (If not specified by the Regulatory Project Manager it defaults to the county midpoint).
- Source: Automatically populated based on the coordinates of the project site.
- Value: Decimal degrees.
- Class: Numeric.

PROJECT_DESCRIPTION

- Applicable dataset: Raw, clean.
- Type of field: Optional.
- Entry-type: Open Ended.
- Description: Description of the authorized project.
- Source: Entered by the Regulatory Project Manager in the permit action data form.
- Value: Open ended character string.
- Class: Character.

PROJECT_NAME

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Open Ended.

- Description: Name of the project (from the application).
- Source: Entered by the Regulatory Project Manager when a new folder is created. Usually is copied from the application.
- Value: Open ended character string.
- Class: Character.

RESOURCE_TYPE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: The type of aquatic resource to be impacted.
- Source: Selected from a menu when entering data in the impact data form.
- Value: One of: Harbor/Ocean, Lake, Non-Tidal Wetland, Other, Pond, River/Stream, Stream/River/Ocean, Tidal Wetland, or NA.
- Class: Character.

STATE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: State where the proposed activity would occur.
- Source: Automatically populated based on the coordinates of the project site, or can be manually entered.
- Value: USGS state code. One of: AK, AL, AR, AS, AZ, CA, CO, CT, DC, DE, FL, GA, GU, HI, ID, KY, LA, MA, MD, ME, MP, MS, NC, NH, NJ, NM, NV, NY, OR, PA, PR, RI, SC, TX, UT, VA, VI, VT, WA, WV, or NA.
- Class: Character.

state

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.

- Description: USGS code of the state where the proposed activity would occur.
- Source: Manually corrected value based on authorizing USACE District.
- Value: One of 39 USPS 2-letter state abbreviations: AK, AL, AR, AS, AZ, CA, CO, CT, DC, DE, FL, GA, GU, HI, ID, KY, LA, MA, MD, ME, MP, MS, NC, NH, NJ, NV, NY, OR, PA, PR, RI, SC, TX, UT, VA, VI, VT, WA, or WV.
- Class: Character.

state_name

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Full name of the state in which the impact was authorized.
- Source: Added from the “coastal.counties.lookup” table and linked with the “STATE” field.
- Value: One of 39 USPS 2-letter state abbreviations: Alaska, Alabama, or Arkansas.
- Class: Character.

VERIFY_TYPE

- Applicable dataset: Raw.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: How the General Permit was verified.
- Source: Selected from a menu in the permit action data form.
- Value: One of: Reverification, Verification of Prior Cycle GP, or NA.
- Class: Character.

WATERS_LATITUDE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Open Ended.

- Description: Latitude of the midpoint of the review area at the impact site. Projection is NAD83, EPSG:4269. (If not specified by the Regulatory Project Manager it defaults to the IMPACT_LATITUDE, which defaults to the county midpoint).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended number.
- Class: Numeric.

WATERS_LONGITUDE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Longitude of the midpoint of the review area at the impact site. Projection is NAD83, EPSG:4269. (If not specified by the Regulatory Project Manager it defaults to the IMPACT_LATITUDE, which defaults to the county midpoint).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended number.
- Class: Numeric.

WATERS_NAME

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Open Ended.
- Description: Name of the aquatic resource to be impacted (can be a name or a unique identifier).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form. Often taken from the application. Unnamed features are often named using an ID number.
- Value: Open ended character string.
- Class: Character.

WATERS_TYPE

- Applicable dataset: Raw, clean.
- Type of field: Required.

- Entry-type: Drop-Down Menu.
- Description: Type of jurisdictional waters as defined in regulation. Changes with changing definition of waters of the U.S.
- Source: Selected from a menu on the Jurisdiction data form.
- Value: One of: A1, A1-1.TNW-404, A1-1.TNW-404.10, A1TNW10, A1TNWCOMM, A1TNWFED, A1TNWSEAS, A2B, A2O, A2TRIBINT, A2TRIBPER, A3, A3-1.TRIB.RPS-404, A3LPIFLOOD, A3LPIFLOW, A4, A4WETABUT, A4WETARTSEP, A4WETFLOOD, A4WETNATSEP, A5, A6BOHWM, A6BWB, A6N1OHWM, A6N1WB, A6N2OHWM, A6N2WB, A6N3HOHWM, A6N3HWB, A7CA, A8100WB, A8HOHWM, A8HWB, A8OOHWM, A8OWB, B10STORM, B1EXCLUDEDOTH, B1LPINOSCFLD, B1SWCNOSC, B1WETNONADJ, B3EPHEMERAL, B5DITCH, CWR, DELIN.CONC, DELIN.NOJD-404, DELIN.NOJD-404.10, DELIN.PJD-404.10, DELINC, DELINEATE, DELINPJD, DRYLAND, EXCLDB1, EXCLDB3I, EXCLDB3II, EXCLDB3III, EXCLDB4II, EXCLDB6, IMPNDMNT, ISOLATE, NOJD10404, NOJD404, NRPW, NRPWW, OTHERA8F, OTHEREB, PJD10404, PJD404, RAPANOS, RHA10NAV, RHAB1WETNONADJ, RHAB3EPHEMERAL, RHAB6PCC, RHATIDAL, RPW, RPWWD, RPWWN, TNW, TNWRPW, TNWW, UPLAND, or NA. See abbreviations section (or “abbreviations.lookup” table) for their meanings.
- Class: Character.

WATERWAY

- Applicable dataset: Raw, clean.
- Type of field: Optional.
- Entry-type: Open Ended.
- Description: Name of the nearest named waterbody (entered by the Regulatory Project Manager).
- Source: Entered by the Regulatory Project Manager in the aquatic resource data form.
- Value: Open ended character string.
- Class: Character.

WORKTYPE

- Applicable dataset: Raw, clean.
- Type of field: Required.
- Entry-type: Drop-Down Menu.
- Description: Type of work authorized.

- Source: Selected from a drop-down menu when entering data in the permit action data form. One must be selected and up to three are allowed. The order in which multiples are selected is not standardized.

- Value: One of 8137 unique combinations of between 1 and 3 selections from 140 unique drop-down menu options. Options are nested into 10 main categories: AGRICULTURE, AQUACULTURE, DEVELOPMENT, DREDGING, ENERGY GENERATION, MINING AND DRILLING, MITIGATION, OTHER, STRUCTURE, or TRANSPORTATION. Nested values are separated by a space-double backslash-space (" \ "). Multiple selections are separated with a comma and space (", ").

- Class: Character.

worktype

- Applicable dataset: Clean.

- Type of field: Derived.

- Entry-type: Refer to field this one was derived from.

- Description: Type of work causing the impact.

- Source: Based on "WORKTYPE" field, but nested values are separated with an underscore "_" and multiple selections are separated with a ",". Selected from a drop-down menu when entering data in the permit action tab. One work type must be selected and up to three are allowed. Multiple selections can be in any order.

- Value: One of 7629 unique combinations of between 1 and 3 selections from 141 drop-down menu options. Options are nested into 10 main categories: AGRICULTURE, AQUACULTURE, DEVELOPMENT, DREDGING, ENERGY, MINING AND DRILLING, MITIGATION, OTHER, STRUCTURE, or TRANSPORTATION. E.g., MITIGATION_RESTORATION_WETLAND; TRANSPORTATION_ROADS_CROSSING (NON BRIDGE), TRANSPORTATION_ROADS_IMPROVEMENTS; OTHER_BANK STABILIZATION, STRUCTURE_BULKHEAD, STRUCTURE_BOAT RAMP.

- Class: Character.

worktype1

- Applicable dataset: Clean.

- Type of field: Derived.

- Entry-type: Refer to field this one was derived from.

- Description: First of up to three types of work causing the impact.

- Source: Extracted from "worktype" field. See "worktype" description for additional details.

- Value: One of 142 unique values, including “NA”. E.g., MITIGATION_RESTORATION_WETLAND, TRANSPORTATION_ROADS_CROSSING (NON BRIDGE), OTHER_BANK STABILIZATION.
- Class: Character.

worktype1A

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: The first level descriptor (level A) of the first of up to three work types selected.
- Source: Extracted from “worktype1”.
- Value: One of: AGRICULTURE, AQUACULTURE, DEVELOPMENT, DREDGING, ENERGY, MINING AND DRILLING, MITIGATION, OTHER, STRUCTURE, TRANSPORTATION, or NA.
- Class: Character.

worktype2

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Second of up to three types of work causing the impact.
- Source: Extracted from “worktype” field. See “worktype” description for additional details.
- Value: One of 129 unique values, including “NA”. E.g., TRANSPORTATION_ROADS_IMPROVEMENTS, OTHER_DAMS_WEIR, STRUCTURE_BULKHEAD.
- Class: Character.

worktype2A

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.

- Description: The first level descriptor (level A) of the second of up to three work types selected.
- Source: Extracted from “worktype2”.
- Value: One of: AGRICULTURE, AQUACULTURE, DEVELOPMENT, DREDGING, ENERGY, MINING AND DRILLING, MITIGATION, OTHER, STRUCTURE, TRANSPORTATION, or NA.
- Class: Character.

worktype3

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Third of up to three types of work causing the impact.
- Source: Extracted from “worktype” field. See “worktype” description for additional details.
- Value: One of 129 unique values, including “NA”. E.g., STRUCTURE_BOAT RAMP, TRANSPORTATION_ROADS_CULVERT, STRUCTURE_DOCK_FIXED.
- Class: Character.

worktype3A

- Applicable dataset: Clean.
- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: The first level descriptor (level A) of the third of up to three work types selected.
- Source: Extracted from “worktype3”.
- Value: One of: AGRICULTURE, AQUACULTURE, DEVELOPMENT, DREDGING, ENERGY, MINING AND DRILLING, MITIGATION, OTHER, STRUCTURE, TRANSPORTATION, or NA.
- Class: Character.

worktypeA_all

- Applicable dataset: Clean.

- Type of field: Derived.
- Entry-type: Refer to field this one was derived from.
- Description: Simplified and alphabetized work types.
- Source: Concatenates “worktype1A”, “worktype2A”, and “worktype3A” in alphabetical order. See “worktype1A” for details.
- Value: One of 107 unique combinations of the first level worktype descriptors. E.g., AGRICULTURE, STRUCTURE, TRANSPORTATION; AQUACULTURE, OTHER; DEVELOPMENT, ENERGY, or TRANSPORTATION.
- Class: Character.

Abbreviations not defined in the metadata:

LOP: Letter of Permission

NWP: Nationwide Permit

PGP: Programmatic General Permit

RGP: Regional General Permit

SP: Standard Permit

GP: General Permit

OHWM: Ordinary High Water Mark

HTL: High Tide Line

A1: See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

A1-1.TNW-404: Traditionally navigable waters (Sec. 404-only). See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

A1-1.TNW-404.10: Traditionally navigable waters (Sec. 404 and Sec. 10). See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

A1TNW10: Traditionally navigable waters (Sec. 10). See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

A1TNWCOMM: Traditionally navigable waters (interstate or foreign commerce). See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A1TNWFED: Traditionally navigable waters (interstate waters). See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A1TNWSEAS: Traditionally navigable waters (territorial seas). See 33 CFR 328.3(a)(1) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A2B: See 33 CFR 328.3(a)(2) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A2O: See 33 CFR 328.3(a)(2) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A2TRIBINT: Intermittent tributary. See 33 CFR 328.3(a)(2) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A2TRIBPER: Perennial tributary. See 33 CFR 328.3(a)(2) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A3: See 33 CFR 328.3(a)(3) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A3-1.TRIB.RPS-404: See 33 CFR 328.3(a)(3) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A3LPIFLOOD: See 33 CFR 328.3(a)(3) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A3LPIFLOW: See 33 CFR 328.3(a)(3) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A4: See 33 CFR 328.3(a)(4) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A4WETABUT: Wetland abutting a jurisdictional water. See 33 CFR 328.3(a)(4) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A4WETARTSEP: Wetland artificially separated from a jurisdictional water. See 33 CFR 328.3(a)(4) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A4WETFLOOD: Wetland flooded by a jurisdictional water. See 33 CFR 328.3(a)(4) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A4WETNATSEP: Wetland naturally separated from a jurisdictional water. See 33 CFR 328.3(a)(4) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A5: See 33 CFR 328.3(a)(5) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6BOHWM: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6BWB: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6N1OHWM: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6N1WB: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6N2OHWM: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6N2WB: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6N3HOHWM: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A6N3HWB: See 33 CFR 328.3(a)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A7CA: See 33 CFR 328.3(a)(7) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A8100WB: See 33 CFR 328.3(a)(8) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A8HOHWM: See 33 CFR 328.3(a)(8) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A8HWB: See 33 CFR 328.3(a)(8) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A8OOHWM: See 33 CFR 328.3(a)(8) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

A8OWB: See 33 CFR 328.3(a)(8) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

B10STORM: Excluded water under Navigable Waters Protection Rule. Stormwater control features. See 33 CFR 328.3(b)(10) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

B1EXCLUDEDOTH: Excluded water under Navigable Waters Protection Rule. Other. See 33 CFR 328.3(b)(1) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

B1LPINOSCFLD: Excluded water under Navigable Waters Protection Rule. See 33 CFR 328.3(b) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

B1SWCNOSC: Excluded water under Navigable Waters Protection Rule. See 33 CFR 328.3(b) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

B1WETNONADJ: Excluded water under Navigable Waters Protection Rule. Non-adjacent wetland. See 33 CFR 328.3(b) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

B3EPHEMERAL: Excluded water under Navigable Waters Protection Rule. Ephemeral waters. See 33 CFR 328.3(b)(3) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

B5DITCH: Excluded water under Navigable Waters Protection Rule. Ditches. See 33 CFR 328.3(b)(5) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

CWR: Clean water rule

DELIN.CONC: Delineation concurrence

DELIN.NOJD-404: Delineation only, no jurisdictional determination (Sec. 404)

DELIN.NOJD-404.10: Delineation only, no jurisdictional determination (Sec. 404 and Sec. 10)

DELIN.PJD-404.10: Delineation only, preliminary jurisdictional determination (Sec. 404 and Sec. 10)

DELINC: Delineation concurrence

DELINEATE: Delineation only

DELINPJD: Delineation only, preliminary jurisdictional determination

DRYLAND: Dry land

EXCLDB1: Excluded water under Clean Water Rule. Waste treatment systems. See 33 CFR 328.3(b)(1) of Definition of Waters of the United States in effect in that State on the “END_DATE” as modified by relevant court rulings

EXCLDB3I: Excluded water under Clean Water Rule. Ephemeral ditches. See 33 CFR 328.3(b)(3)(i) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

EXCLDB3II: Excluded water under Clean Water Rule. Intermittent ditches excavated in uplands. See 33 CFR 328.3(b)(3)(ii) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

EXCLDB3III: Excluded water under Clean Water Rule. Isolated ditches excavated in uplands. See 33 CFR 328.3(b)(3)(iii) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

EXCLDB4II: Excluded water under Clean Water Rule. Artificial ponds. See 33 CFR 328.3(b)(4)(ii) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

EXCLDB6: Excluded water under Clean Water Rule. Stormwater control features. See 33 CFR 328.3(b)(6) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

IMPNDMNT: Impoundments

ISOLATE: Isolated waters

NOJD10404: No jurisdictional determination (Sec. 404 and Sec. 10)

NOJD404: No jurisdictional determination (Sec. 404)

NRPW: Non-relatively permanent water

NRPWW: Non-relatively permanent wetland water

OTHERA8F: Other jurisdictional water. See 33 CFR 328.3(a)(8) of Definition of Waters of the United States in effect in that State on the "END_DATE" as modified by relevant court rulings

OTHEREB: Other

PJD10404: Preliminary jurisdictional determination (Sec. 404 and Sec. 10)

PJD404: Preliminary jurisdictional determination (Sec. 404)

RAPANOS: Rapanos

RHA10NAV: Navigable water under Sec. 10 Rivers and Harbors Act. See 33 CFR 329

RHAB1WETNONADJ: Navigable water under Sec. 10 Rivers and Harbors Act. See 33 CFR 329

RHAB3EPHEMERAL: Navigable water under Sec. 10 Rivers and Harbors Act. See 33 CFR 329

RHAB6PCC: Navigable water under Sec. 10 Rivers and Harbors Act. See 33 CFR 329

RHATIDAL: Navigable water under Sec. 10 Rivers and Harbors Act. See 33 CFR 329

RPW: Relatively permanent water

RPWWD: Relatively permanent water

RPWWN: Relatively permanent water

TNW: Traditionally navigable water

TNWRPW: Relatively permanent traditionally navigable water

TNWW: Traditionally navigable wetland water

UPLAND: Upland

CHAPTER 3: DIFFERENT TREATMENT OF OCEAN AND TIDAL VERSUS FRESHWATER HABITATS BY THE U.S. ARMY CORPS OF ENGINEERS REGULATORY PROGRAM

Abstract

The U.S. Army Corps of Engineers Regulatory Division (Corps) has arguably the broadest authority of any federal agency to regulate private activities in ocean and tidal waters. However, the Corps' regulation of fill in freshwater systems overshadows its regulation of ocean and tidal activities. Very little is known about basic patterns of permitting in ocean-tidal waters, including the magnitude that these impacts have on ocean-tidal habitats. The Corps' Institute for Water Resources previously found that impacts to ocean and non-wetland coastal habitats were rarely required to provide compensation. This paper analyzes the Corps' 2012-2022 permit data from coastal counties to explore whether this difference is due to differences in the nature of ocean/tidal impacts, which makes them less likely to meet the Corps' criteria for requiring compensatory mitigation, or to factors related to the Corps' policies and practices. Compensation rate for ocean/tidal impacts were six times lower compared with freshwater impacts and the odds of compensatory mitigation was four times less likely if the impact occurred in an ocean/tidal system, even after controlling for whether an impact met the criteria for requiring compensation. My results suggest that achieving equal compensatory mitigation rates should start with applying existing policy equally.

Introduction

The ocean is quickly becoming the new frontier for development. From wave and wind energy to marine aquaculture, people are exploring new ways of using the ocean's resources. Ports continue to expand, and coastal communities are re-thinking their land-sea border in the

face of sea level rise and other coastal hazards. These activities can have negative effects on the ocean and coasts (Defeo et al., 2009; Griggs, 2005; Loflin, 1995; e.g., Maragos, 1993; Peterson & Bishop, 2005; Taormina et al., 2018; Williams et al., 2015; Young, 2015), with the costs paid for by fishermen, surfers, and anyone whose livelihood depends on a thriving coastal ecosystem. Environmental laws and regulations play a primary role in protecting the ocean by reducing the negative effects human activities have on the marine environment. Examples of this include the Coastal Zone Management Act, National Marine Sanctuaries Act, and Clean Water Act.

In the United States (U.S.), the U.S. Army Corps of Engineers Regulatory Division (Corps) has broad authority to regulate activities in ocean and coastal waters, such as the construction of structures, installations on the sea floor, and discharges of dredged or fill material (33 U.S.C. 403; 43 U.S.C. 1333(e); 33 U.S.C. 1344). However, the scope of this broad authority is restricted to the construction activities and to a certain extent, the location of the facility. Despite the limited scope, the Corps is frequently the principal federal regulator of activities in offshore waters.

The Corps' two primary regulatory mandates are to: protect the capacity of the nation's navigable waters under Section 10 of the Rivers and Harbors Act (33 U.S.C. 403 of 1899 as amended; Section 10, hereafter), and protect the flow of the nation's water for the benefit of fisheries, wildlife, recreational users, and consumers under Section 404 of the Clean Water Act (33 U.S.C. 1344 of 1972 as amended; Section 404, hereafter).

Geographically, Section 10 and Section 404 overlap. In oceanic and tidally influenced waters, Section 404 authority extends further inland to the High Tide Line (33 CFR 328.4(b)) versus the Mean High Water line (33 CFR 329.12(a)(2)). However, Section 10 authority extends further offshore past the 3-nautical mile limit of "state waters" and Section 404 authority (33

CFR 328.4(a)) to the seaward limit of Outer Continental Shelf (33 CFR 322.3(b)) [**Error! Reference source not found.** in ***Appendix 3-A***]. In freshwater systems, Section 404 authority extends further inland covering all "waters of the U.S." as defined at 33 CFR 328.3. Section 10 also covers freshwater systems, but only those that are, have been, or had the potential to be used in foreign or interstate commerce (33 CFR 329.4).

The types of activities regulated under Section 10 and Section 404 also overlap. Section 404 regulates the discharge of dredged or fill material (33 CFR 323.2). Section 10 also regulates discharges of dredged or fill material, but also governs all types of structures or work that occur in, over, or under navigable waters (33 CFR 322.2). This can include temporary construction cranes extending over a river or hydraulic directional drilling under a harbor channel.

This is where the similarities end. These authorities differ substantially in their purpose and environmental review process. The purpose of Section 10 is to protect the navigable capacity of the nation's waters. The purpose of Section 404 is to protect aquatic resources. As such, the U.S. Environmental Protection Agency (EPA) has oversight of the Corps' Section 404 permitting program, but not Section 10. Therefore, while permits issued under Section-10-only must comply with the procedural requirements of the National Environmental Policy Act (NEPA) and the Corps' long-standing Public Interest Review, permits issued under Section 404 must *also* comply with the EPA's 404(b)(1) Guidelines.

Compensatory Mitigation Policy

After more than a century of implementing these rules and adapting to executive action and judicial verdicts, the Corps has honed its regulatory identity. It sees itself as a neither a proponent nor opponent of development, with a mission to balance aquatic resource protection

and economic development. To accomplish this balancing act, the Corps requires applicants to avoid and minimize adverse environmental effects to the maximum extent practicable and requires compensatory mitigation for any unavoidable and significant aquatic resource losses, typically in the form of restoring a similar resource elsewhere (33 CFR 320.4(r)). Compensatory mitigation was originally applied solely to support the goal of having no net loss of wetlands that was established by Executive Order 11990 (24 May 1977, 42 F.R. 26961) (see also Hough & Robertson, 2009), but has expanded to other aquatic resource types, such as streams and eelgrass beds (U.S. EPA, 2023; USACE, 2021).

Nevertheless, in the early 2000's the Corps was authorizing a net loss of wetlands and other freshwater systems. The cause was twofold: permits authorizing the filling of wetlands either did not require enough compensatory mitigation to offset the loss, or the Corps did not adequately enforce the compensatory mitigation requirement—or both (A. O. Allen & Feddema, 1996; Kentula et al., 1992; National Research Council, 2001; Sifneos et al., 1992).

The Corps responded by jointly promulgating the 2008 Mitigation Rule with EPA. Since 2008, the Corps applies its "General Regulatory Policies" (33 CFR 320) to determine *when* compensatory mitigation will be required. Specifically, "compensatory mitigation will be for significant resource losses which are specifically identifiable, reasonably likely to occur, and of importance to the human or aquatic environment" (33 CFR 320.4(r)). The 2008 Mitigation Rule (33 CFR 332) is used to determine how much and what type of compensatory mitigation will be required.

The General Regulatory Policies establish a high bar for when to require compensatory mitigation. In contrast, the 404(b)(1) Guidelines serves to lower the bar for requiring compensatory mitigation from an identifiable loss to "degradation" (40 CFR 230.1(d)). This is

particularly true for habitats designated as "Special Aquatic Sites." The term includes wetlands, mudflats, coral reefs, and submerged aquatic vegetation (40 CFR 230.3(m)). EPA's intention that the Corps should also consider degradation and lost resource *functions* when deciding whether to require compensatory mitigation is visible in the 2008 Mitigation Rule too, where the Rule states compensatory mitigation will be required "based on what is practicable and capable of compensating for the aquatic resource *functions* that will be lost as a result of the permitted activity" (33 CFR 332.3(a)(1), emphasis added). Recall, the 404(b)(1) Guidelines only apply to activities involving a discharge of dredged or fill material and therefore, regulated under Section 404.

The 2008 Mitigation Rule also established a preference for Mitigation Banks and In-Lieu Fee Programs over "permittee-responsible" compensatory mitigation. Mitigation Banks and In-Lieu Fee Programs (also referred to as Third-Party Providers) perform habitat restoration activities today to sell future credits to project proponents for unavoidable adverse effects to aquatic resources. These programs serve to consolidate the number of compensatory mitigation projects the Corps must monitor for compliance and to increase the value of the restored areas, since the sites can be larger with fewer edge effects. The Corps' 2008 Mitigation Rule Retrospective (2015) found that since the Rule, the number of approved Mitigation Banks selling wetland credits increased by 52%, while the number of banks selling stream credits increased 200%. There are a small number of Third-Party Providers that sell eelgrass or shallow subtidal estuarine credits (USACE, 2023). However, these types of credits weren't mentioned in the Corps' Retrospective Report (IWR, 2015).

Compensatory mitigation after 2008 has proven to be an effective tool in support of the no net loss policy for wetlands, rivers, and streams, but only for Section 404 activities. Impacts authorized under Section 10 rarely been required to perform compensatory mitigation (IWR,

2015). This is due in part to the nature of Section-10-only activities, which includes activities like the construction of an overhead power line across a river, and in part to the high bar set by the General Regulatory Policies.

Over the years, the Corps has occasionally required compensatory mitigation for damage to coral reefs, seagrass, oyster reefs, tidal flats, and even shallow subtidal habitat (Bentivoglio, 2003; U.S. EPA, 2023). Compensatory mitigation projects for impacts to coral reefs have consisted of designating marine protected areas and transplanting coral (Bentivoglio, 2003; CRTF, 2016). For impacts to seagrass, compensatory mitigation projects have consisted of preserving existing seagrass, transplanting or seeding new seagrass, and restoring topography to support natural recruitment (U.S. EPA, 2023). For impacts to oyster reefs, compensatory mitigation projects have consisted of preserving existing oyster reefs, seeding, and restoring topography to support natural recruitment (U.S. EPA, 2023). For impacts to tidal flats, compensatory mitigation projects have consisted of preserving existing tidal flats and removing tidal restrictions from wetland complexes (U.S. EPA, 2023). For impacts to shallow subtidal habitat, compensatory mitigation projects have consisted of removing tidal restrictions, remediating sediment contamination, or removing derelict materials or structures (U.S. EPA, 2023).

However, of the 4,129 mitigation banks and in-lieu fee programs listed on the Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS) website (USACE, 2023), only 54 were for estuarine or marine habitat (U.S. EPA, 2023). This seems to indicate that compensatory mitigation for these habitats may be less common than for freshwater systems.

This research seeks to describe the Corps' permitting in ocean and tidal habitats in relation to freshwater systems and to determine whether the lower compensatory mitigation

rates for Section-10-only activities translates into to lower compensatory mitigation rates for ocean and tidal habitats. Assuming a difference is found, I propose and test two hypotheses as to why: 1) impacts to ocean and tidal systems do not typically meet the criteria for "significant resource losses" or "degradation" of a "special aquatic site," and therefore a lower compensatory mitigation is expected, and 2) despite differences between the types of impacts occurring in ocean/tidal versus freshwater systems, the Corps still requires compensation for impacts in freshwater systems more often.

Methods

Data and Software

I obtained data for permits issued or verified between 1 January 2012 and 31 December 2022 by Corps Districts with a maritime coastline through a FOIA request submitted to the Corps on 10 January 2023. The data consist of information entered about permit applications by the Corps' Regulatory Project Managers into the ORM2 database.

All data organization, processing, and analysis steps were performed using R (v4.3.0, R Core Team, 2022) run in RStudio. Chapter 4 describes the data and cleaning process in more detail. The raw and processed data are available here: ***https://doi.org/10.5061/dryad.jwstqjqgn***. The processing steps use functions from an R package I developed called "ORMimportr" (v0.1.1; Protopapadakis F. (2023a)).

The data within the ORM2 database are entered by Corps' Regulatory Project Managers during the review process for each permit application. The ORM2 database is primarily used to track workload, evaluate performance, and summarize the program's actions for Congress.

Some fields are required, while others are optional. Some fields are entered by selecting from a drop-down menu of pre-determined values, while others are open-ended. Also, the database has evolved over time to accommodate changing regulations. These factors make the ORM2 data notoriously challenging to use (Bronner et al., 2013; Fong, 2015). Since 2014, the Corps has taken steps to introduce quality assurance and quality control measures during data creation (IWR, 2015). Fields that the Corps uses internally (e.g., for tracking workload or assessing performance) are more thoroughly scrutinized and are relatively reliable. For example, there is a non-significant mean difference of 0.035 acre (P = 0.212, alpha = 0.99) between the entered impact areas and the impact areas extracted from other descriptive fields in the data (Chapter 2).

Data Processing

Steps taken to clean and restructure the raw data are described in Chapter 2. Briefly, I imported the raw data I received from the Corps into R. Then, I used several functions in the "ORMimportr" package to flag entries that raised concern, such as inconsistent spatial information and impact amounts. I reviewed these entries by hand in excel.

After completing the manual review, I imported the changes back into R and updated the data with the correct values. Where possible, I also filled in or cleaned up missing values. I added several fields from look-up tables to enhance or clarify information in the ORM2 data and added other fields derived from existing fields. Finally, I restructured the data so that each observation in the dataset represents a single impact authorized by the Corps. Because the inland area far exceeds the coastal area within each District's area of responsibility, I also filtered the data to retain only impacts from coastal counties. This ensures that comparisons

across aquatic system (i.e., ocean/tidal versus freshwater) are founded on a more equivalent geographic area.

From this cleaned data, I created several additional fields specific to this analysis. The final dataset used for this research contains 235,585 impact observations, described by 85 variables. Chapter 2 contains a statistical description of the data. Appendix 2-C (in Chapter 2) gives definitions for all the variables in the dataset. The methods I used to derived new fields for this dataset is described below. The meanings of the field values used in this analysis are described in the Analysis section.

Derived fields

Severity ("duration_level")

This field combines information about the impact duration (temporary or permanent) and the severity (loss or no loss) into a variable with three possible values: Temporary, Permanent impact, and Permanent loss.

Impact Direction ("impact_direction")

This field identifies whether the authorized impact was expected to provide a net benefit for the aquatic resource. I flagged impacts as beneficial if 1) the impact type was one of ecological restoration or removal of a structure; 2) the General Permit used authorizes restoration activities, cleanup of hazardous substances, removal of vessels from a waterbody, emergency watershed protection measures, or removal of low head dams; or 3) the work type field(s) are all related to mitigation/restoration, cleanup of hazardous substances, dam removal,

or structure removal, including the removal of bridges and rail lines. I considered all other impacts to be "adverse."

Aquatic System ("impact_habsys," "impact_habsys_cowonly")

These fields categorize the aquatic system at the impact site into "Ocean/Tidal" or "Freshwater." For the "impact_habsys_cowonly" field, I only used the Cowardin classification (Cowardin et al., 1979) to inform the categorization. For the "impact_habsys" field, I used the resource type of "Tidal Wetland" or "Non-Tidal Wetland" first and then the Cowardin classification to inform the categorization. This was done to address the concern that 2,802 observations with a resource type of "tidal wetland" were also classified as a palustrine system, rather than estuarine (Chapter 2) and because the simplicity of the resource type field makes it more reliable at distinguishing tidal from non-tidal wetlands.

Size threshold associated with compensatory mitigation requirements ("mit_threshold")

This field indicates whether the size of the impact is above the mitigation threshold or not. Specifically, if the impact area is greater than 0.03 acre of streambed or 0.1 acre of other aquatic resources, including ocean and tidal habitats. These thresholds come from the thresholds found in the Nationwide Permit federal register notice for when to require compensatory mitigation.

Special Aquatic Site ("impact_sas_binary") and Permit Authority ("permit_auth_binary")

These fields have been simplified into a dichotomous variable for use in the predictive models. The values for the field "impact_sas_binary" are "SAS" (special aquatic site) and "Not

SAS." The values for the field "permit_auth_binary" are "Section 10" (e.g., without Section 404) or "w/ Section 404" (e.g., combines Section 10/404 and Section 404-only into one category.

Marine Ecoregion ("region")

This field is an approximate marine ecoregion based on the U.S. state or territory in which the authorized impact occurred. These regions are Alaska, California, Florida & Caribbean, Gulf Coast, North Atlantic, Northwest, Pacific Islands, and South Atlantic. To create them, observations from Alaska and California were grouped in their same-named regions; observations from American Samoa, Guam, Hawaii, and the Northern Mariana Islands were grouped in the Pacific Islands region; observations from Alabama, Louisiana, Mississippi, and Texas were grouped in the Gulf Coast region; observations from Florida, Puerto Rico, and the Virgin Islands were grouped in the Florida and Caribbean region; observations from Georgia, North Carolina, South Carolina, and Virginia were grouped in the South Atlantic region; and observations from Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia were grouped in the North Atlantic region. Appendix 3-B shows how these regions are related to the Corps' Divisions.

Work Type ("worktype1A_plus," "worktype2A_plus," "worktype3A_plus," and "worktypeA_plus_all")

These fields are based on the "WORKTYPE" field in the raw data. This field categorizes the type of project the permit request is associated with. For example: transportation, development, or agriculture. Project Managers' select from three identical drop-down menu containing a list of 137 pre-defined work types. Each drop-down list is independent of the other

two. The Project Manager is required to select one work type from the first list, the other two lists are optional. If the project manager selects more than one work type, the ORM2 data output contains all selections concatenated together into a single value in the order they are selected. The "WORKTYPE" field contains 6,002 unique combinations.

The possible values for work type contain nested levels of detail, for example "Development / Residential / Single Family" or "Development / Recreational." The options for the first level of detail are: Structure, Development, Mitigation, Transportation, Other, Dredging, Energy, Mining And Drilling, Aquaculture, and Agriculture.

In most cases, the first level of detail is sufficient to describe the type of activity. For the "Other" and "Structure" categories, the second level is more informative. Therefore, I replaced "Other" and "Structure" with the second-level descriptors from the work type field. Examples of the second-level descriptors under the "Other" category are: Bank Stabilization, Survey Activities, and Dams. Examples of the second-level descriptors under the "Structure category are: Dock, Pier, and Boating Structure. In some cases, I collapsed these second-level descriptors into a common category (e.g., boat lift, boat ramp, boat house all became"boating structure") to reduce the total number of unique values for these fields.

To create the derived fields, I first captured the 1st, and if applicable, the 2nd and 3rd work types in separate fields (i.e., "worktype1," "worktype2," and "worktype3"). Then I reduced the level of detail for each field as described above (i.e., to the first-level descriptor for all but "Other" and "Structure", where the second-level descriptor was used) to create the "worktype1A_plus," "worktype2A_plus," and "worktype3A_plus" fields. Finally, I concatenated these "A_plus" fields in alphabetical order into a single field ("worktypeA_plus_all"). The result reduced the number of unique work type values to 1,353.

Analysis: Descriptive Statistics

I used four metrics to compare authorized impacts in ocean/tidal systems with those in freshwater systems: 1) the number of impacts authorized, calculated as the count of all impacts or "observations" within a group; 2) the total area of authorized impacts, calculated as the sum of impact area for all observations within a group; 3) the geometric mean of impact area, calculated as the n'th root of the product of all n observations using the "geoMean" function from the "EnvStats" package (v2.7.0 Millard & Kowarik, 2023); and 4) the compensatory mitigation rate, calculated as the percent of observations with required compensatory mitigation relative to all observations in the group.

Unless otherwise noted, the term "mean" refers to the geometric mean. I used geometric mean instead of the arithmetic mean because it provides a more stable way of comparing log-normally distributed data (Limpert et al., 2001). Since these data are a complete enumeration of the impacts authorized within the scope of my study and not a sample, statistical tests for difference are not necessary.

Analysis: Logistic Regression

I use generalized logistics models to test my two hypotheses. Logistics models are used to estimate the odds of a desired outcome given a set of independent variables.

Ocean/tidal impacts are different from freshwater impacts

To test the first hypothesis—that ocean/tidal impacts tend not to meet the criteria for requiring compensatory mitigation compared with freshwater impacts—I estimate the odds that

an impact site is ocean/tidal, given a set of several variables related to the Corps' criteria for requiring compensatory mitigation. For this model, I restricted the data to only adverse impacts and used the following four predictor variables: size relative to the mitigation threshold, severity, location relative to a special aquatic site, and the type of permit used. These variables are described in the next section.

I set up this model such that success is when the aquatic system is ocean/tidal. The variable levels are ordered from more likely to meet the criteria for requiring compensatory mitigation to less likely. Therefore, positive coefficients indicate ocean/tidal impacts are less likely to meet the criteria for requiring compensatory mitigation for that variable. For example, if the variable was "location in a special aquatic site," the values are ordered from "in a special aquatic site" to "not in a special aquatic site," and a positive coefficient indicates that ocean/tidal impacts are more likely to occur "not in a special aquatic site."

The null hypothesis, that these variables cannot be used to determine the aquatic system of the impact, is rejected if the model does a significantly better job of predicting the aquatic system than a prediction based on the mean outcome. Rejection of the null hypothesis supports the hypothesis that ocean/tidal impacts are different from freshwater impacts.

Location in an ocean/tidal system has a significant effect on whether compensatory mitigation is required

To test the second hypothesis—that despite differences in the types of impacts, the Corps still requires compensation for freshwater systems more often—I use aquatic system to predict when compensatory mitigation would be required while controlling for the factors related to the criteria for requiring compensatory mitigation and the environmental review process (i.e.,

permit authority). For this model, I restricted the data to only adverse impacts greater than the mitigation threshold and used the remaining three variables from the first model (severity, location relative to a special aquatic site, and the type of permit used) plus two additional variables: aquatic system and permit authority.

I set up this model such that success is when compensatory mitigation is required. This time, the variable levels are ordered from less likely to meet the criteria for requiring compensatory mitigation to more likely. Therefore, positive coefficients in a variables likelihood of increasing the odds that compensatory mitigation will be required. For example, if the variable was "location in a special aquatic site", the values are ordered from "not in a special aquatic site" to "in a special aquatic site", and a positive coefficient indicates that compensatory mitigation is more likely to occur "in a special aquatic site".

The model is accepted if it does a significantly better job of predicting the compensatory mitigation requirement than a model based solely on the mean rate in the data. The null hypothesis, that the other variables explain all the difference in compensatory mitigation rates observed across aquatic system, is rejected if the coefficient associated with the term for aquatic system is significant. Rejection of the null hypothesis indicates support for the hypothesis that aquatic system affects whether compensatory mitigation would be required after controlling for all other factors.

Mitigation-Related Variables

Below, are descriptions of the variables I included in the models and how the variable assists in identifying "significant resource loss" or "degradation" of a special aquatic site.

Impact direction

Projects designed to have a net benefit on aquatic resources, such as a voluntary stream restoration project, may still require authorization from the Corp and may have temporary or permanent impacts. However, if the project would result in a net increase in functions provided by the aquatic resource, then the project is considered beneficial and would not require compensatory mitigation. Other projects such as the removal of a structure or cleanup of hazardous material would also result in a net improvement to the aquatic environment and therefore would likely not require compensatory mitigation.

Impact severity

Temporary impacts are those in which the activity is only planned for a limited time, such as construction-related impacts, maintenance of existing structures or fill, or pilot projects. After the activity stops or the structure is removed, the aquatic resource is expected to recover or be restored per special conditions in the permit. For this reason, the Corps does not typically require compensatory mitigation for temporary impacts.

Permanent impacts are expected to persist indefinitely. In addition to the duration of the impact, the Corps also distinguishes between permanent impacts and permanent losses in the ORM2 database, to facilitate reporting to congress and the executive branch under the "No Net Loss" of wetlands policy. A "loss," as used by the Corps in ORM2, means the activity would remove the aquatic resource from the Corps jurisdiction (USACE Regulatory Division, 2021). An example of this would be draining a portion of a wetland to construct a driveway. Losses are almost always the result of a discharge of fill, rather than a structure. For example, for bridge footings in a Water of the U.S. (Section 404), the area filled by the footings is considered a

permanent loss. However, the bridge over the non-navigable waterway is not a jurisdictional impact. In contrast, the Corps does not consider piles to be fill because the impacted area is so small and placed far enough apart that they don't have the effect of fill. Therefore, a fishing pier over a navigable waterway (Section 10) is considered a permanent impact, because the structure will permanently shade the water below, but since the waterway still exists under this structure, the impact is not considered a "loss."

Note that this definition of loss is different from the definition used in the Nationwide permit program to indicate whether the activity qualifies for the permit and different from the usage in the 2008 Mitigation Rule. The Nationwide permit program defines loss as "permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of the waterbody" (USACE, 2017). The 2008 Mitigation Rule does not define loss directly but applies the term within the definition of temporal loss to mean "the loss of aquatic resource functions" (33 CFR 332.2). The Corps' General Policies at 33 CFR 320.4(r) are unclear on whether the phrase "significant resource loss" means the conversion of an aquatic resource to dry land or whether it means the significant loss of aquatic resource functions. In this study, I assume that the General Policies use "loss" to mean conversion to dry land and therefore the Corps is more likely to require compensatory mitigation for permanent losses because those are more likely to result in a "significant resource loss" and cross the threshold for requiring compensatory mitigation (33 CFR Part 320.4(r)(2)).

Size relative to the mitigation threshold

Impacts greater than 0.1 acre (0.04 hectare (ha)) are more likely to trigger compensatory mitigation requirements. This threshold is found in General Condition 23 to the Nationwide Permits (see 86 FR 2761). While General Condition 23 only applies to Nationwide Permits, the

threshold of 0.1 acre (0.04 ha) is a common rule of thumb applied to all permits (IWR, 2015) as one factor of many considered considering when determining whether to require compensatory mitigation.

Special Aquatic Sites

Special aquatic sites are defined under the EPA's 404(b)(1) Guidelines and include wetlands, mud flats, vegetated shallows, and coral reefs (40 CFR 230). The 404(b)(1) Guidelines establish the guiding principle that any "degradation or destruction of special aquatic sites" by definition "may represent an irreversible loss of valuable aquatic resources." These guidelines go on to require that any Section 404 permit be denied if it would result in "significant degradation" of the aquatic environment, which includes any unmitigated adverse "effect on special aquatic sites." Therefore, discharges of dredged or fill material into special aquatic sites are more likely to be required to provide compensatory mitigation as a condition of the Corps' permit.

Permit authority

As discussed in the introduction, the Corps has two principle regulatory authorities: Section 10 and Section 404. They overlap in their geographic jurisdiction and jurisdictional activities, but differ substantially in their purpose and standards of environmental review. For efficiency, the Corps evaluates all the impacts associated with these Section 10/404 activities as it would for Section 404-only activities (Hough & Robertson, 2009). For this research, I make the distinction between Section 10-*only* impacts and impacts *involving* Section 404.

Section-10-only impacts can be discharges of fill offshore of state waters (e.g., trenching for a trans-pacific cable) but are mostly for structures and work over navigable waters. In contrast, impacts involving Section 404 are *only* discharges of dredged or fill material but either can be in waters where Section 10 and Section 404 overlap or in inland waters that are not jurisdictional under Section 404. Based on the differences between the policies that govern Section 10 and Section 404, the Corps may be more likely to require compensatory mitigation for activities involving Section 404 (i.e., discharges of dredged or fill material into navigable waters and Waters of the U.S.) than Section-10-only activities (i.e., structures and work affecting navigable waters).

Permit type

The Corps issues three types of permits somewhat distinguished by how harmful the activity is expected to be. General Permits authorize categories of activities that have no more than *minimal* individual and cumulative adverse environmental effects (33 U.S.C. 1344(e)). Letters of Permission are individual permits for categories of *minor* activities (can be more than minimal) that would not have significant individual or cumulative impacts on environmental values and should encounter no appreciable opposition (33 CFR 325(e)(1)). Standard Permits are individual permits used for activities that do not qualify for another type of permit or are likely to have more than minor adverse effects on the environment.

General Permits are authorized every five years by Corps Headquarters (Nationwide Permits) or Corps Districts (Regional General Permits). At the time the General Permit is issued, the Corps evaluates the category of activity for compliance with the 404(b)(1) Guidelines, Public Interest Review, and completes the procedural requirements of NEPA. When required by the terms or conditions of the General Permit, project proponents seeking to use it must submit a

"pre-construction notification" to the Corps for "verification". The Corps tracks the processing of pre-construction notifications the same way it tracks the processing of individual permits. The Corps confirms the activity meets the terms and conditions of the General Permit, determines that it would have no more than minimal adverse effects on the environment after considering compensatory mitigation, and evaluates it for compliance with other environmental statutes (e.g., Section 7 of the Endangered Species Act (ESA)). If compensatory mitigation is necessary to ensure no more than minimal adverse effects, it is required as a special condition to the verification.

Letters of Permission are a type of individual permit that can be processed using special procedures established through a rule-making process. Corps Headquarters established procedures for minor Section-10-only activities in 1986. In addition, some Corps Districts have also established procedures for certain minor Section 404 activities. Letters of permission are categorically excluded from NEPA (33 CFR Appendix B, Item 6(a)(5)). After receiving an application for a Letter of Permission, the Corps completes its Public Interest Review, evaluates the activity for compliance with other environmental statutes, and, if Section 404 applies, compliance with the 404(b)(1) Guidelines.

For Standard Permits, the Corps must complete the procedural requirements of NEPA, including a public notice and 30-day public comment period, complete the Public Interest Review, evaluate the activity for compliance with other environmental statutes, and, if applicable, determine compliance with the 404(b)(1) Guidelines.

Aquatic system at the impact site

This variable indicates whether the impact occurs in an ocean/tidal system or a freshwater one. The Corps does not specifically distinguish between these types of resources when implementing its policies and Project Managers who process permits for impacts to ocean/tidal systems also process permits for impacts to freshwater systems.

Form of the Model

The logistics model uses the logistic function to describe the relationship between the dependent variable and the independent variables. Specifically, the logistics function is used to estimate the probability of an event occurring from the linear combination of one or more independent variables (Glantz et al., 2016). The log-odds (logit) function, written below, is the inverse of a standard logistics function (Glantz et al., 2016).

$$\text{logit}\left(\mathbb{E}\left[Y_i|x_{1,i},\ \ldots,\ x_{m,i}\right]\right) = \text{logit}(p_i) = ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_{1,i} + \ldots + \beta_m x_{m,i}$$

where:

$$Y_i = \text{predicted outcome}_i$$
$$p_i = \text{probability of the desired outcome}$$
$$x_{1,i},\ldots,x_{m,i} = \text{the set of m explanatory variables}$$
$$\beta_0,\ldots,\beta m = \text{regression coefficients}$$

This linear predictor function can then be fitted to a transformation of the expected value of the variable to estimate the coefficients (Glantz et al., 2016).

For both analyses, I used the "glm" function for fitting generalized linear models from the "stats" package (stats v4.3.0; R Core Team and contributors worldwide (2023)). The binomial distribution with the logit link function (i.e., family = binomial (link = "logit")) was used to analyze error terms and transform the linear probabilities of the levels of the categorical explanatory variables to a continuous scale. The model is fit using iteratively reweighted least squares (from the "glm" function's documentation). The regression coefficients indicate the relative effect the associated explanatory variable has on the outcome. Effect is reported as the odds ratio, which is the exponated coefficients ($OR = e^{\beta}$).

In the first model, $Y = \textit{aquatic system}$ with $m = 4$ explanatory variables, such that $x_1 = \textit{size relative to the mitigation threshold}$, $x_2 = \textit{severity}$, $x_3 = \textit{location relative to a special aquatic site}$, and $x_4 = \textit{permit type}$. In the second analysis, $Y = \textit{compensatory mitigation requirement}$ with $m = 5$ explanatory variables, such that $x_1 = \textit{aquatic system}$, $x_2 = \textit{severity}$, $x_3 = \textit{location relative to a special aquatic site}$, $x_4 = \textit{permit type}$, and $x_5 = \textit{permit authority}$.

Goodness of fit for both models are estimated using a goodness-of-fit chi square, in which $\chi^2 = \sum \frac{(O-E)^2}{E}$. Observed values ($O$) are obtained by identifying all possible combinations (i.e., patterns) of values across the explanatory variables and, for each pattern, calculating the rate of the desired outcome (i.e., ocean/tidal system in the first model and compensatory mitigation is required in the second model). Expected values (E) are obtained by using the model to predict the probability of the desired outcome for each pattern. I used the "pchisq" function from the "stats" package to give the probability (p-value) that a smaller difference between observed and expected values could occur by random chance (i.e., by guessing based on the rate of the occurrence of the outcome in the data), with $n_p - k - 1$ degrees of freedom, where n_p is the number of patterns and k is the number of explanatory variables.

Significance of coefficients are estimated using the Wald z-statistic calculated within the "glm" function. Significant differences in effect (modeled coefficients) between two variables are estimated using the Wald χ^2 test, which was calculated using the "wald.text" function in the "aod" package (aod v1.3.2; Lesnoff & Lancelot (2022)).

Based on exploratory analysis of the data, there is a substantial difference in compensation rates between freshwater and non-wetland ocean or tidal systems. This large difference in the desired outcome, combined with the large sample size (n = 235,585) gives a relatively high power to differentiate between the null hypothesis and the alternative, thus lowering the risk of falsely rejecting the null hypothesis when using a high confidence level. Therefore, I selected a confidence level of 0.99% ($p < 0.01$) to minimize the risk of falsely accepting the alternative hypothesis.

Results: Descriptive Statistics

General Patterns

Between 2012-2022, the Corps authorized slightly more ocean/tidal impacts in coastal counties than freshwater impacts (Figure 3-1a). When the Corps issues a permit, the applicant is not obligated to implement the project. Assuming all authorized activities were implemented, ocean/tidal impacts affected a substantially larger area (Figure 3-1b). However, freshwater impacts had a larger mean impact size at 0.036 acre (0.015 hectares (ha)) compared with the 0.017 acre (0.0069 ha) for ocean/tidal impacts (Figure 3-1d).

The median size of freshwater impacts (0.039 acre, 0.016 ha) was slightly larger than the mean (0.036 acre, 0.015 ha). In contrast, the median size of ocean/tidal impacts (0.013 acre,

0.0051 ha) was a little smaller than the mean (0.017 acre, 0.0069 ha), indicating a larger number of very small ocean/tidal impacts, such as minor modifications to individual boat docks. In addition, the maximum impact size in ocean/tidal systems is larger than in freshwater systems and more ocean/tidal impacts lie at the very large end of the spectrum (Figure 3-1d).

The overall compensatory mitigation rate was 17.4%. The compensatory mitigation rate for freshwater impacts was 31.3%, whereas the compensatory mitigation rate for ocean/tidal impacts was substantially less at 5.1%.

Over Time

The number of total authorized impacts increased 35.8%, from 16,723 impacts to 22,712 impacts between 2012 and 2022 (Figure 3-2a). This increase was more pronounced for ocean/tidal impacts, which increased 47.1% from 9,099 impacts in 2012 to 13,382 impacts in 2022. The number of impacts authorized in freshwater systems also increased over the study period, but only by 22.4% from 7,624 impacts in 2012 to 9,330 impacts in 2022 (Figure 3-2a). The overall increase was not a steady one. From 2012 to 2014, the number of impacts increased, with the impacts authorized in the two systems tracking together. From 2014 to 2019, the number of impacts authorized dipped and then increased again, with the impacts in freshwater systems lagging impacts in ocean/tidal systems by one year. After 2019, the number of impacts authorized in each system decoupled. Impacts authorized in ocean/tidal systems remained relatively constant between 2019 and 2022, while freshwater impacts dropped -46.1% between 2019 and 2021. From 2021 to 2022, the number of impacts authorized in freshwater systems rebounded by 20.4%.

The total area of impacts in coastal counties from 2012-2022 was more volatile than the number of impacts authorized. Total impact area in ocean/tidal waters increased by 86.6%, whereas total impact area in freshwater decreased by -44.5%. The total impact area peaked in 2022 driven by the peak total ocean/tidal impact area at 100,636 acres (40,727 ha) also in 2022. Ocean/tidal impact area also increased substantially between 2016 and 2017 from 21,917 to 59,813. Freshwater impacts peaked in 2020 with 28,117 acres (11,379 ha). The reason for this volatility is not known.

In contrast with the number of impacts authorized, the mean impact size decreased for both systems. The -57.8% decrease in mean ocean/tidal impact size from 0.037 acre (0.015 ha) in 2012 to 0.016 acre (0.0063 ha) in 2022 was more substantial than the -20.5% decrease in mean freshwater impact size from 0.041 acre (0.017 ha) in 2012 to 0.033 acre (0.013 ha) in 2022. The mean size of ocean/tidal impacts dropped -73.2% from 2012 to 2015 and then remained relatively steady hovering between 0.019 acre and 0.013 acre through 2022. In contrast, the mean impact size of freshwater impacts remained relatively constant from 2012 to 2016, was quite volatile between 2016 and 2020 and then declined steadily through 2022. Except for 2012, the difference in the mean impact size of freshwater impacts was always at least 0.011 acre larger than the mean impact size of ocean/tidal impacts.

Overall, the rate at which compensatory mitigation was required decreased -33.4% over the study period from 21.1% in 2012 to 14% in 2022, with a peak of 23.5% in 2018 (Figure 3-2d). The reason for this decrease may be related to a decline in the compensation rate for General Permits that occurred concurrent with a decrease in the mean impact size of a General Permit (data not shown). Notably, the compensation rate for freshwater impacts was at least 4.7 times greater than the rate for ocean/tidal impacts each year of the study period. Also, the compensation rate for ocean/tidal impacts was relatively stable compared with freshwater

impacts. Over the study period, the year-to-year change in compensation rate for ocean/tidal impacts was never more than 2.9 percentage points, whereas the compensation rate for freshwater impacts changes as much as 15.7 percentage points. The compensation rate for freshwater impacts peaked in 2018 at 40.8%. In contrast, the peak compensation rate for ocean/tidal impacts occurred in 2012 at 5.7%.

Across Regions

The Corps authorized the greatest number of impacts from 2012-2022 in North Atlantic, Gulf Coast, and Florida/Caribbean regions, and fewest in Pacific Islands and Alaska (Figure 3-3a). The regions in which ocean/tidal impacts accounted for more than 50% of all impacts authorized are the Pacific Islands (76.3%), Florida & Caribbean (72.5%), and North Atlantic (62.3%). Alaska (30.3%) and California (30.2%) authorized the lowest proportion of ocean/tidal impacts relative to all impacts authorized in their respective region. The number of impacts authorized in the Pacific Islands was very small relative to the other regions. Only 1,616 impacts were authorized from 2012-2022 in this region. For comparison, the region with the second fewest impacts authorized, Alaska, authorized 8,323 impacts. Because of the relatively small number of impacts authorized, the composition of types of requests coming in during the study period would have a strong effect on the results observed here. Therefore, conclusions about the results from the Pacific Island region should be made cautiously.

The Northwest had the largest mean impact size in ocean/tidal systems and the smallest mean impact size in freshwater systems (Figure 3-3b). The relatively large mean size of ocean/tidal impacts in the Northwest appears to be due to the large mean size of aquaculture-related impacts in the region (3.44 acres) combined with the large number of ocean/tidal, aquaculture-related impacts authorized in the region (3,164 or 44.4% of ocean/tidal impacts and

18.4% of all impacts authorized in the region). This combination is unique to this region. The Gulf Coast was the only other region for which the mean size of aquaculture-related impacts was greater than an acre at 3.97 acres. But the Gulf Coast only authorized 162 aquaculture-related impacts during the study period. California is the only other region for which the mean size of ocean/tidal impacts is larger than the mean impact size of freshwater impacts. The relatively large mean size of ocean/tidal impacts in California appears to be due to the relatively larger mean size of dredging-related impacts (0.48 acre) combined with the relatively large number of ocean/tidal, dredging-related impacts authorized in the region (754 or 13.6% of ocean/tidal impacts in the region).

Compensatory mitigation rates varied widely across the regions (Figure 3-3c). The South Atlantic (33%), Alaska (30.6%), Northwest (23.6%), California (22.2%), Florida & Caribbean (18.4%), and Gulf Coast (17.4%) have region-wide compensation rates above the study-wide rate of 17.36%. The regions with ocean/tidal compensation rates that exceed the study-wide rate of 5.1% for ocean/tidal impacts are the Florida/Caribbean (7.0%), Gulf Coast (6.4%), Northwest (6.3%), and California (6.2%). Excluding the Pacific Islands, the regions with the lowest compensation rates in ocean/tidal systems were South Atlantic (4.9%), Alaska (3.6%), and North Atlantic (2.9%). The compensatory mitigation rates in ocean/tidal systems were at least 14 percentage points lower than compensation rates in freshwater systems across all regions except the Pacific Islands. Regions with a difference between ocean/tidal and freshwater compensation rates of more than 25 percentage points were South Atlantic (46%), Florida & Caribbean (41.4%), Alaska (38.8%), and Northwest (29.4%).

Permit Type

In coastal counties during the study period, Corps Districts used General Permits to authorize the majority of all impacts (82.6%), followed by Standard Permits (12.1%), and Letters of Permission (5.3%; Figure 3-4a). General Permits also accounted for the majority of ocean/tidal impacts (83.4% or 104,533 out of 125,365) and freshwater impacts (81.7% or 90,026 out of 110,220). Standard Permits accounted for a larger percentage of freshwater impacts (17.1%) than ocean/tidal impacts (7.7%). In contrast, Letters of Permission accounted for a smaller percentage of freshwater impacts (1.2%) than ocean/tidal impacts (8.9%). Figure 3-4a also shows ocean/tidal impacts account for 53.7% (104,533 of 194,559) of General Permits, 89.3% (11,126 of 12,454) of Letters of Permission, and 34% (9,706 of 28,572) of Standard Permits.

While General Permits authorized the largest number of impacts, Standard Permits authorized the largest total area impacted (276,168 acres compared with 257,548 acres under General Permits and 83,318 acres under Letters of Permission; data not shown) because Standard Permits authorized substantially larger impact areas on average (0.18 acre) than either General Permits (0.018 acre) or Letters of Permission (0.021 acre). Figure 3-4b also shows that for Letters of Permission and Standard Permits, impacts in ocean/tidal systems had larger mean impact sizes (0.022 and 0.26 acre, respectively) than those in freshwater systems (0.016 and 0.15 acre, respectively).

Overall, compensation rates for Standard Permits were the highest of the three permit types (67.7% compared with 12.2% for Letters of Permission and 10.3% for General Permits; Figure 3-4c). This is unsurprising because Standard Permits authorize larger impact areas and undergo more scrutiny. The compensation rates were substantially less for ocean/tidal impacts

regardless of permit type (28.7% for Standard Permits, 8.3% for Letters of Permission, and 2.5% for General Permits) compared with the respective compensation rates for freshwater impacts (87.8% for Standard Permits, 44.8% for Letters of Permission, and 19.3% for General Permits). This is consistent with the overall difference in compensation rates between the two systems reported earlier (5.1% and 31.3% for ocean/tidal and freshwater impacts, respectively). Interestingly, the difference between compensation rates was the greatest for Standard Permits (59.1 percentage points compared with 36.5 points for Letters of Permission and 16.7 points for General Permits). This implies that the increased rigor of the review (Standard Permits over Letters of Permission over General Permits) has a bigger effect on the compensation rates of freshwater impacts than of ocean/tidal impacts.

Type of Work

For ocean/tidal systems, docks and piers accounted for the largest numbers of impacts authorized, aquaculture facilities and generic structures accounted for the largest impact areas, while “mitigation, recreational structure” and “development, energy, utilities” impacts accounted for the largest mean impact size (Table 3-1). The drop-down menu of options for the work type field does not include an option for voluntary restoration. Since it is a required field, project managers often select the next closest work type, “mitigation.” As a result, the term “mitigation” in the context of work type, can mean voluntary restoration, the construction of a Mitigation Bank, activities of an In-Lieu Fee Program, or permittee-responsible compensatory mitigation. This is a known issue and will be corrected in the next version of ORM (Karen Mulligan, U.S. Army Corps of Engineers, pers. com.). After reviewing the project descriptions for the impacts of work type “mitigation, recreational structure,” it appears this work type was frequently used to describe the construction of an artificial reef, which has permanent impacts

but is also expected to have a net benefit on the aquatic environment (see Appendix 3-C, Table 3-5 for details).

For freshwater systems, transportation and development projects accounted for the largest number of impacts authorized, development and mitigation (meaning mitigation or restoration) projects accounted for the largest total impact areas, while "development, energy, utilities" and "development, mining and drilling" projects accounted for the largest mean impact size (Table 3-1). Interestingly, the total impact area and mean impact size of the work types with the largest ocean/tidal impacts was substantially larger than the total impact area and mean impact size of the work types with the largest freshwater impacts.

For the work types that are dominant in ocean/tidal systems, compensation rates are still lower for ocean/tidal systems than in freshwater systems (Figure 3-5). Only "development, energy, utilities" and "mitigation, recreational structure" had higher compensatory mitigation rates for ocean/tidal impacts compared with freshwater impacts. (Recall that mitigation in this context can mean restoration). These work types also had very few observations, so one should be cautious about drawing conclusions from this finding. Surprisingly, compensation rates for piers in freshwater systems were 20.1 percentage points higher than in ocean/tidal systems.

Results: Predictive Models

Ocean/tidal impacts are different from freshwater impacts

The first model tested whether ocean/tidal impacts differ from freshwater impacts in ways that makes them less likely to meet the Corps' criteria for compensatory mitigation. It did

this by "predicting" the aquatic system (i.e., ocean/tidal or freshwater) from variables that relate to "significant resource loss" or "degradation" of "special aquatic sites".

The null hypothesis—that ocean/tidal impacts are no different from freshwater impacts across factors related to the Corps' criteria for requiring compensatory mitigation—can be rejected with 99% confidence because it does a significantly better job at predicting the probability of an impact occurring in an ocean/tidal system than a model based solely on the mean probability for the data set (log-likelihood ratio test, p = 0e+00). Furthermore, the deviation of predictions from the observed values for each pattern is unlikely to be due solely to chance (chi-square goodness-of-fit test, p = 1.5e-17). Instead, the results support the hypothesis that ocean/tidal impacts are less likely to cause substantial resource loss or degradation of a special aquatic site and therefore, are less likely to require compensatory mitigation.

All the included variables are significant in predicting the aquatic system and all coefficients are positive (Table 3-2). These results means ocean/tidal impacts are more likely to occur in non-special aquatic sites, be authorized with a General Permit over a Letter of Permission over a Standard Permit (and therefore have minimal adverse effects), involve a temporary impact over a permanent impact over a permanent loss, and be of a size that is less likely to trigger compensatory mitigation requirements (Table 3-2).

Non-special aquatic sites had the largest predictive effect, increasing the odds that the impacted system was ocean/tidal by a factor of 6 all else equal, followed by Letters of Permission (Odds Ratio (OR) = 5.6) and permanent impacts (OR = 5.2). The effects of these three are not significantly different from each other but are significantly different from the effects of a temporary impact, General Permit, or size below the mitigation threshold (refer to Wald Test results in Appendix 3-D).

Differences between ocean/tidal and freshwater impacts do not fully explain the lower compensatory mitigation rates for ocean/tidal impacts

The second model tested whether compensation rates for ocean/tidal impacts were lower than rates for freshwater impacts even after controlling for differences in the environmental review process (i.e., permit authority) and the nature of the impact (i.e., the variables from the first model). It did this by "predicting" the compensatory mitigation requirement based on the variables used in the first model, permit authority, and aquatic system (i.e., ocean/tidal or freshwater).

The null hypothesis—that all the difference in compensatory mitigation rates between aquatic systems can be explained the variables that relate to the Corps' criteria for determining when compensatory mitigation will be required and permit authority—can be rejected with 99% confidence because the coefficient for aquatic system was significant ($p = 3.4e\text{-}307$). While aquatic system did not have as large an effect as the other variables, location in a freshwater system increases the odds that compensatory mitigation is required by a factor of 4.03 compared with an ocean/tidal one, even after controlling for all other related variables.

This model does a significantly better job at predicting the probability of compensatory mitigation than a model based solely on the mean probability for the data set (log-likelihood ratio test, $p = 0e+00$). Furthermore, the deviation of predictions from the observed values for each pattern is unlikely to be due solely to chance (chi-square goodness-of-fit test, $p = 1.14e\text{-}23$. In addition, all the terms are significant with 99% confidence (Table 3-3).

Permit type with a change from Letter of Permission to Standard Permit had the largest effect, increasing the odds of compensatory mitigation by a factor of 12.8, all else equal (Table

3-3). Permanent losses compared with permanent impacts had the second largest effect, increasing the odds of compensatory mitigation by a factor of 8.4, all else equal. Special aquatic sites had the third largest effect (OR = 6.8).

A Wald test comparing the coefficient associated with aquatic system with the coefficients for the other variables indicates that the effect of aquatic system on compensatory mitigation requirements is significantly greater than the effect of shifting from a temporary impact to a permanent one (p = 0e+00) and equivalent to the effect of permit authority (p=0.979). It has significantly less effect than shifting from a General Permit to a Letter of Permission (p = 0.006), shifting from a Letter of Permission to a Standard Permits (p = 0e+00), shifting from a permanent impact to a permanent loss (p = 0e+00), or shifting to a location in a special aquatic site (p = 0e+00; Appendix 3-D, Table 3-9).

These results support the hypothesis that even though the impacts authorized in ocean/tidal systems are significantly less likely to meet the Corps' compensatory mitigation criteria than freshwater impacts, these differences do not explain all the observed difference in compensatory mitigation rates.

To better understand where the differences in compensation rates are the greatest, I compared the compensation rates across ocean/tidal and freshwater systems for each pattern in which the permit authority included Section 404 (Figure 3-6). Panel A shows compensatory mitigation rates, while Panel B shows the differences in compensation rates.

The pattern at the top of the figure, Standard Permits authorizing permanent loss in a special aquatic site, has the second highest compensatory mitigation rate of all the patterns in ocean/tidal waters (91%, the pattern with the highest rate is not shown) and is the pattern with

the highest compensation rates in freshwater systems (95%). As a result, the freshwater compensation rate for this pattern is only 4.3 percentage points greater than the ocean/tidal compensation rates. The second pattern from the top of the figure only differs from the first pattern in that the impact site is *not* in a special aquatic site. This pattern also has a relatively high freshwater compensation rate (83%), but the ocean/tidal compensation rate (35%) is 48.6 percentage points lower, the biggest difference of any pattern.

The third and fourth patterns from the top, Standard Permit authorizing permanent impacts within and not within special aquatic sites, also exhibit a decrease in the compensation rate when the site is not a special aquatic site and the ocean/tidal compensation rate decreases more than the freshwater compensation rate, making for a larger difference between the two rates when the impact is not in a special aquatic site (28.4 percentage points when not in a special aquatic site compared with 21.2 percentage points when in a special aquatic site).

The compensation rates for the fifth and sixth patterns from the top, General Permits authorizing permanent loss within, and not within, special aquatic sites, show that the ocean/tidal and freshwater compensation rates decrease by about the same amount when the site is not a special aquatic site.

The ocean/tidal and freshwater compensation rates for the seventh and eighth patterns from the top, General Permits authorizing permanent impacts within, and not within, special aquatic sites, also decrease when the site is not a special aquatic site. However, because the ocean/tidal compensation rate for General Permits authorizing permanent impacts within a special aquatic site is already so low (4.4%), the freshwater rate decreases more when the site is not a special aquatic site, making for a larger difference between the freshwater and ocean/tidal

rates. These results indicate that impacts in a freshwater non-special aquatic site are more likely to be mitigated for than impacts in an ocean/tidal non-special aquatic site.

Discussion

The goal of this research was to better understand the patterns and trends in the Corps' permitting in ocean/tidal systems including compensatory mitigation rates relative to those for impacts to freshwater systems. Ocean/tidal impacts account for the majority of authorized impacts in coastal counties and the largest share of the affected area. The number of ocean/tidal impacts grew over the study period. In contrast, the number of freshwater impacts declined sharply from 2019 to 2021. This may be related to the 2019 change to the definition of waters of the U.S. (later vacated in 2021), which reduced the scope of the Corps' jurisdiction in freshwater systems. With the latest Supreme Court ruling in Sackett vs the Environmental Protection Agency (No. 21-454, decided on 25 May 2023) and the subsequent promulgation of a yet another new definition of waters of the U.S. (88 FR 61964, published on 8 September 2023), the scope of the Corps' jurisdiction in freshwater systems is likely to shrink again, and with it may come another decline in the number of freshwater permit requests. In contrast, the number of ocean/tidal permit requests is likely to keep growing due to increasing needs for coastal protection and growing use of the ocean to produce food and generate energy.

I proposed that the types of impacts which commonly occur in ocean/tidal systems are different from those in freshwater systems in ways that make them less likely to be substantial resource losses or degradation of special aquatic sites and therefore less likely to require compensatory mitigation. Furthermore, I proposed that those differences and differences in the environmental review process for Section 10 and Section 404 still do not explain the observed difference in compensation rates. My results confirm both hypotheses. Ocean/tidal impacts are

more likely than freshwater impacts to fall short of the Corps' criteria for when to require compensatory mitigation. In addition, even after controlling for these differences and differences in the environmental review, ocean/tidal impacts are still four times less likely to require compensatory mitigation.

These results show that differences between the nature and environmental review of ocean/tidal and freshwater impacts do not fully explain the large discrepancy between their compensatory mitigation rates. Other factors not contained in the ORM data may explain this difference. For example, the Corps may value unvegetated freshwater habitats, such as stream beds, more than ubiquitous, unvegetated ocean/tidal habitats, such as beaches and the soft-bottom benthos. This explanation is supported by my finding that the compensatory mitigation rate for ocean/tidal impacts in non-special aquatic sites, resulting in a permanent loss and authorized with a Standard Permit under Section 404, is 49 percentage points lower than for similar freshwater impacts. This possible devaluation of unvegetated habitats, may be more a factor for ocean and tidal habitats, as the Corps has been authorizing increasing numbers of stream mitigation banks since 2008 (IWR, 2015) and added a requirement to the 2021 nationwide permits for proposed streambed mitigation when permanent impacts exceed 0.03 acre (USACE, 2021). This explanation is further supported by an EPA report (2023) which found evidence for this bias in the permit files of estuarine and marine mitigation projects.

For ocean impacts, another explanation could be that freshwater and wetland impacts are more visible and so the public is more aware of their adverse effects, which means that the Corps' permits for these impacts are under more scrutiny. Research into why the Corps compensatory mitigation program has expanded from wetlands to streambeds may provide insight into the extent to which this explanation factors into the Corps' compensatory mitigation decisions.

Providing compensatory mitigation for ocean and tidal habitats can be more expensive and logistically challenging than freshwater restoration (CRTF, 2016). In addition, marine habitat restoration projects have mixed rates of success and may take a long time to achieve performance standards (Levrel et al., 2012; Merkel & Associates Inc., 1998; NOAA Fisheries, 2014; Pondella et al., 2006; Thanner, 2017). Furthermore, the 2008 Mitigation Rule does not translate well to ocean and coastal habitats. For example, the 2008 Mitigation Rule requires that compensatory mitigation projects have "site protection," which is defined as "long-term protection" through "real estate instruments" or through "federal facility management plans" or "integrated natural resource management plans" if the site is on government property (33 CFR 332.7(a)). Site protection for marine habitats would require that the compensatory mitigation site be located within a protected area of some kind that has regulations or a management plan governing the use of those waters. This may explain why all the existing mitigation banks are located within partially enclosed bays or harbors (USACE, 2023). Indeed, site protection is listed by the Coral Reef Task Force as a challenge for coral reef compensatory mitigation options in their Handbook on Coral Reef Impacts (2016).

It is possible that Corps Regulatory Project Managers are sensitive to these challenges and may therefore be reluctant to require compensatory mitigation. In support of this idea, there is evidence of Corps staff using "out-of-kind" mitigation, in which non-ocean/tidal mitigation is used to compensate for ocean/tidal impacts (U.S. EPA, 2023). Alternatively, Corps staff may to encourage project proponents to design projects in ways that avoid adverse effects on ocean and tidal special aquatic sites, thus shifting impacts to unvegetated, soft-bottom ocean and tidal sites. This explanation is consistent with the discussion above about unvegetated sites being undervalued. It is also supported by the EPA's recent report on Compensatory Mitigation in Estuarine and Marine Habitats that found 60% of permittee-responsible, marine and estuarine, mitigation projects were for shallow water impacts (U.S. EPA, 2023).

This study follows the same line of questioning as a series of academic papers published in the 1990s and early 2000s focused on the Corps Regulatory Program's effect on wetlands. These papers demonstrated that the Corps was authorizing a net loss of wetlands, coral reefs, and other sensitive habitats (A. O. Allen & Feddema, 1996; Bentivoglio, 2003; e.g., Kentula et al., 1992; National Research Council, 2001; Sifneos et al., 1992; Sudol & Ambrose, 2002) and led to a significant change in the Corps compensatory mitigation policy. Other studies have documented substantial harm caused to ocean and tidal habitats by Corps permitted activities like dredging in sensitive habitats, shoreline armoring, and structures over water (Dugan & Hubbard, 2006; Griggs, 2005; Loflin, 1995; Maragos, 1993; Shafer, 1999). My results add to these previously documented findings, showing that over the last 10 years the Corps has permitted 2,474 acres of unmitigated *losses* to ocean/tidal special aquatic sites and an additional 5,691 acres of unmitigated *losses* in ocean/tidal non-special aquatic sites.

Despite the importance of the Corps' role in regulating ocean and tidal activities, no previously published study has compared the Corps' permitting in freshwater systems with its permitting in ocean/tidal systems. A report by the Corps' Institute for Water Resources (2015) comes the closest. However, this analysis evaluated ORM2 data from all Corps Districts between the years 2010-2015, while my study focuses on coastal counties between the years 2012-2022. The report found non-tidal wetlands to suffer the largest total impact area nationwide. My results are contrary, indicating that in coastal counties ocean/tidal habitats, specifically harbors and oceans, suffer the largest total impact area. The Institute for Water Resources report did not compare compensation rates by aquatic resource type (i.e., aquatic system), but did compare compensation rates across permit types. Despite the different spatial and temporal scopes, the compensation rates I reported for Letters of Permission and General Permits are remarkably similar to the Institute for Water Resources report. However, the compensation rates I found for Standard Permits was higher (68% vs 49%). The explanation for this is not clear, but is likely

related to the differences in scope. Because the Institute for Water Resources report did not compare compensatory mitigation rates across resource types, it did not uncover the substantially lower mitigation rates for ocean/tidal impacts across all permit types. In fact, despite looking at total impact size by resource type, the coastal part of the Corps' Regulatory Program was only briefly mentioned, reflecting a lack of attention to impacts occurring in ocean/tidal waters.

Recommendations

Apply existing policy equally to impacts in ocean/tidal and freshwater systems

The results of this study show that increasing the compensation rate for ocean/tidal impacts authorized under Section 404 will improve the parity between compensatory mitigation rates for the two systems. Therefore, one relatively simple step the Corps could take toward ensuring the Regulatory Program does not cause a net loss of ocean or tidal resources would be to improve the parity with which existing policy is applied to permanent impacts in ocean/tidal systems, particularly those in non-special aquatic sites, when the impact is adverse and greater than 0.1 acre (0.04 ha) and falls under the jurisdiction of Section 404. This type of impact represents 28.9% of all adverse impacts greater than 0.1 acre (0.04 ha) in ocean/tidal habitats. Applying existing policy more uniformly to permanent impacts in ocean/tidal systems authorized under Section 404, particularly impacts in non-special aquatic sites, could improve the parity between the compensation rates for the two systems. Due to the regionalized decision-making framework, this could be achieved at the district level via internal guidance and training on marine ecology generally and the importance of soft-bottom ocean/tidal habitat. This approach would not require any rulemaking, which makes it relatively quicker and easier to

implement in a single District. However, widespread adoption in all coastal Districts would require coordination among the coastal Districts or with Corps Headquarters.

Modernize the General Regulatory Policies

Another step the Corps could take to bring parity to the mitigation rates of ocean/tidal and freshwater habitats would be to modernize how it interprets its regulations at 33 CFR 320.4(r). The General Regulatory Policies on mitigation at 33 CFR 320.4(r) describe the circumstances under which the Corps would require compensatory mitigation for any activity it authorizes. Specifically, the Corps appears to interpret the term "loss" in this regulation to mean "converting the resource to dry land," consistent with the national policy on no net loss of wetlands and in opposition to how the term is used in the 2008 Mitigation Rule as "a loss of function." However, given the clear statement in the 2008 Mitigation Rule at 33 CFR 332.1(b) that the intent is *not* to alter the circumstances under which compensatory mitigation is required, this step may require new rulemaking. Therefore, the Corps could modernize the General Regulatory Policies to allow "degradation" and functional loss to trigger compensatory mitigation requirements.

Adapt the 2008 Mitigation Rule for ocean/tidal impacts

The Corps could also modernize the 2008 Mitigation Rule to add flexibility to the site protection requirements, particularly when it comes to ocean/tidal restoration projects. This recommendation would also require joint rulemaking by EPA and the Corps at the Headquarters level.

Conclusion

The results of this study indicate that impacts in ocean/tidal waters are a growing part of the Corps Regulatory Program in coastal counties. It also shows that impacts to ocean/tidal waters are less likely to meet the Corps' criteria for when to require compensatory mitigation, so having a somewhat lower rate of compensatory mitigation in these areas is expected. However, even after controlling for those differences, impacts to ocean/tidal waters are still under-compensated compared with freshwater systems. The 49-percentage-point lower compensatory mitigation rate for permanent losses to ocean/tidal, non-special aquatic sites, authorized by a Standard Permit, when Section 404 was involved indicates that the Corps can make substantial improvements in this disparity between habitats by improving compensation rates for permanent ocean/tidal impacts authorized under Section 404 at the district level and without time-consuming changes to the regulations.

Tables

Table 3-1: Comparison across descriptive statistics for select work types authorized by the Corps.Selected work types were most common (count), had the largest total impact area (total), or largest mean impact area (geometric mean) for impacts in ocean/tidal systems authorized by the Corps in coastal counties from 2012-2022. Note: I excluded work types with fewer than 10 observations when calculating the geometric mean to ensure the results were representative and not biased by one unusual project.

Metric and Rank	Ocean/Tidal	Freshwater
Count (#1)	Dock (N=12,217)	Transportation (N=43,254)
Count (#2)	Pier (N= 9,911)	Development (N=22,079)
Total (#1)	Aquaculture (total=135,520 acres)	Development (total= 32,337 acres)
Total (#2)	Generic structure (total= 99,842 acres)	Mitigation (total= 23,137 acres)
Geometric Mean (#1)	Mitigation, recreational structure (mean=91.6 acres)	Development, energy, utilities (mean=2 acres)
Geometric Mean (#2)	Development, energy, utilities (mean=28 acres)	Development, mining and drilling (mean=1.7 acres)

Table 3-2: Output of the first model.This model tested whether aquatic system could be predicted by 4 variables related to the Corps' criteria for requiring compensatory mitigation. The table gives the relative effect of each variable (Coefficient), odds ratio (OR), confidence interval (0.5% and 99.5%), p-value and an indication of whether the effect of that predictor is significant with 99% confidence ("Signif."). The significant p-value of the log-likelihood ratio test supports the alternative hypothesis, that ocean/tidal impacts can be distinguished from freshwater impacts based on the values of these variables.

Predictor	Coefficient	OR	0.5 %	99.5 %	p.value	Signif.
SAS to Not SAS	1.80	6.05	5.88	6.22	0.0e+00	*
SP to LOP	1.71	5.55	5.07	6.09	0.0e+00	*
Loss to Permanent impact	1.66	5.24	5.05	5.43	0.0e+00	*
Permanent to Temporary Impact	0.52	1.68	1.62	1.74	0.0e+00	*
LOP to GP	0.40	1.49	1.43	1.56	2.2e-124	*
Above to Below Threshold	0.05	1.05	1.02	1.08	1.6e-04	*
Intercept	-2.24	0.11	0.10	0.11	0.0e+00	*

** significant with 99% confidence (p < 0.01).*
Null deviance = 302341 on 218899 degrees of freedom.
Residual deviance = 228602 on 218893 degrees of freedom.
AIC = 228616.
Log-likelihood ratio test, p = 0.

Table 3-3: Output of the second model. This model tested whether aquatic system had a significant effect on predicting compensatory mitigation requirements while controlling for variables related to the Corps' criteria for requiring compensatory mitigation and environmental review process (i.e., permit authority). The significant p-value of the log-likelihood ratio of the difference in residuals between the proposed and null models (p=0) indicates we can accept this model as a useful one in explaining when compensatory mitigation might be required.

Predictor	Coefficient	OR	0.5 %	99.5 %	p.value	Signif.
Intercept	-5.96	0.00	0.00	0.00	0.0e+00	*
LOP to SP	2.55	12.79	11.74	13.94	0.0e+00	*
Permanent impact to loss	2.13	8.43	7.81	9.10	0.0e+00	*
Not SAS to SAS	1.92	6.80	6.21	7.44	0.0e+00	*
GP to LOP	1.70	5.45	4.11	7.15	2.6e-56	*
Sec. 10 to w/ Sec. 404	1.40	4.04	3.16	5.25	1.6e-45	*
Ocean/Tidal to Freshwater	1.39	4.03	3.67	4.44	3.4e-307	*
Temporary to Permanent impact	0.83	2.28	2.08	2.51	7.1e-115	*

** Significant with 99% confidence (p < 0.01).*
Null deviance = 70886 on 54865 degrees of freedom.
Residual deviance = 37287 on 54858 degrees of freedom.
AIC = 37303.
Log-likelihood ratio test, p = 0.

Figures

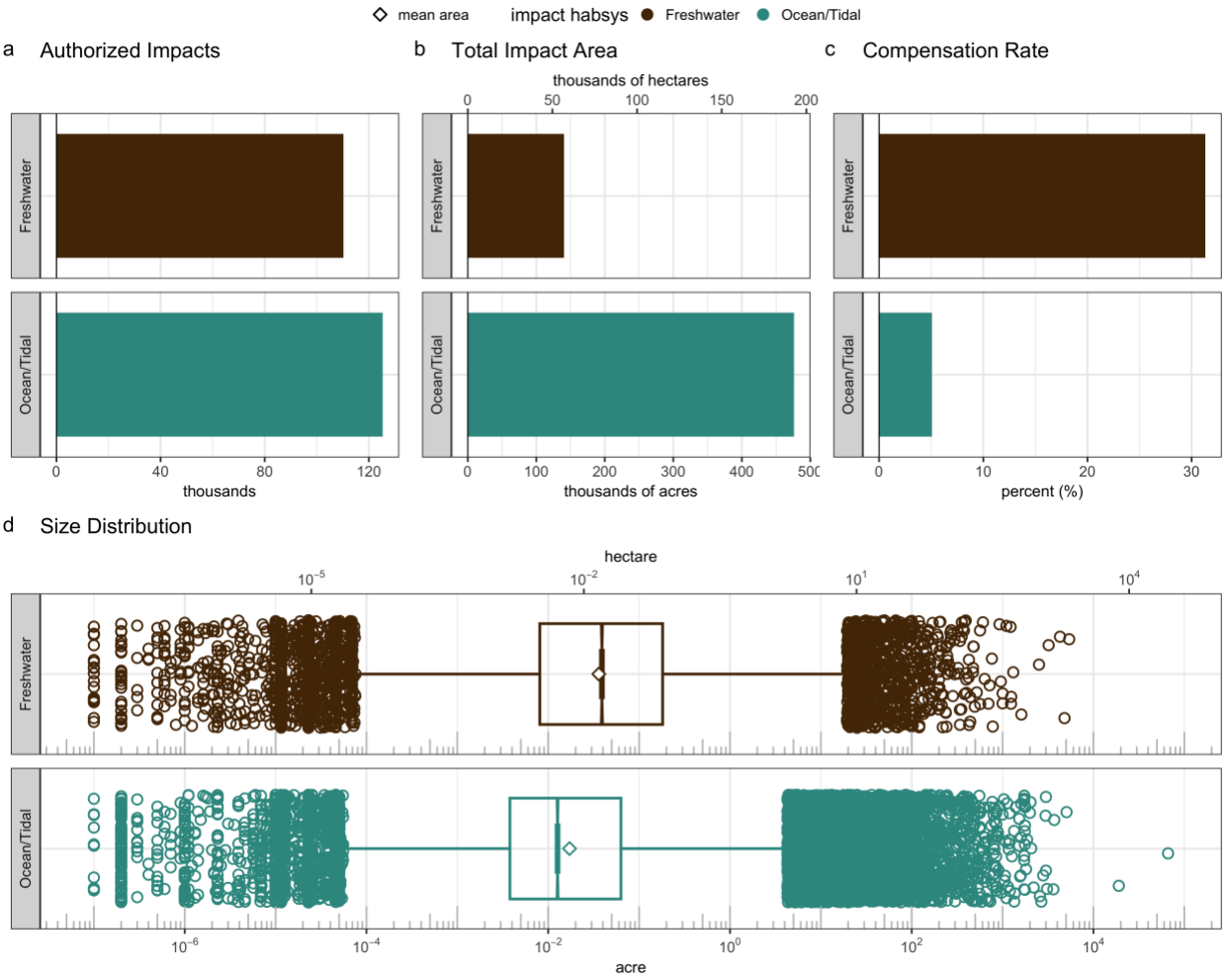

Figure 3-1: Impacts authorized by the Corps in coastal counties from 2012-2022 by aquatic system. (a) Number of impacts authorized. (b) Total area impacted. (c) Rate at which compensatory mitigation is required. (d) Boxplot of impact area on the log scale showing the median (vertical line), arithmetic^{+} mean (diamonds), 25th and 75th percentiles (lower and upper hinges), 1.5 times the interquartile range (whiskers), and outliers (each circle represents a single observation). $^{+}$The arithmetic mean on the log scale is equivalent to the geometric mean.

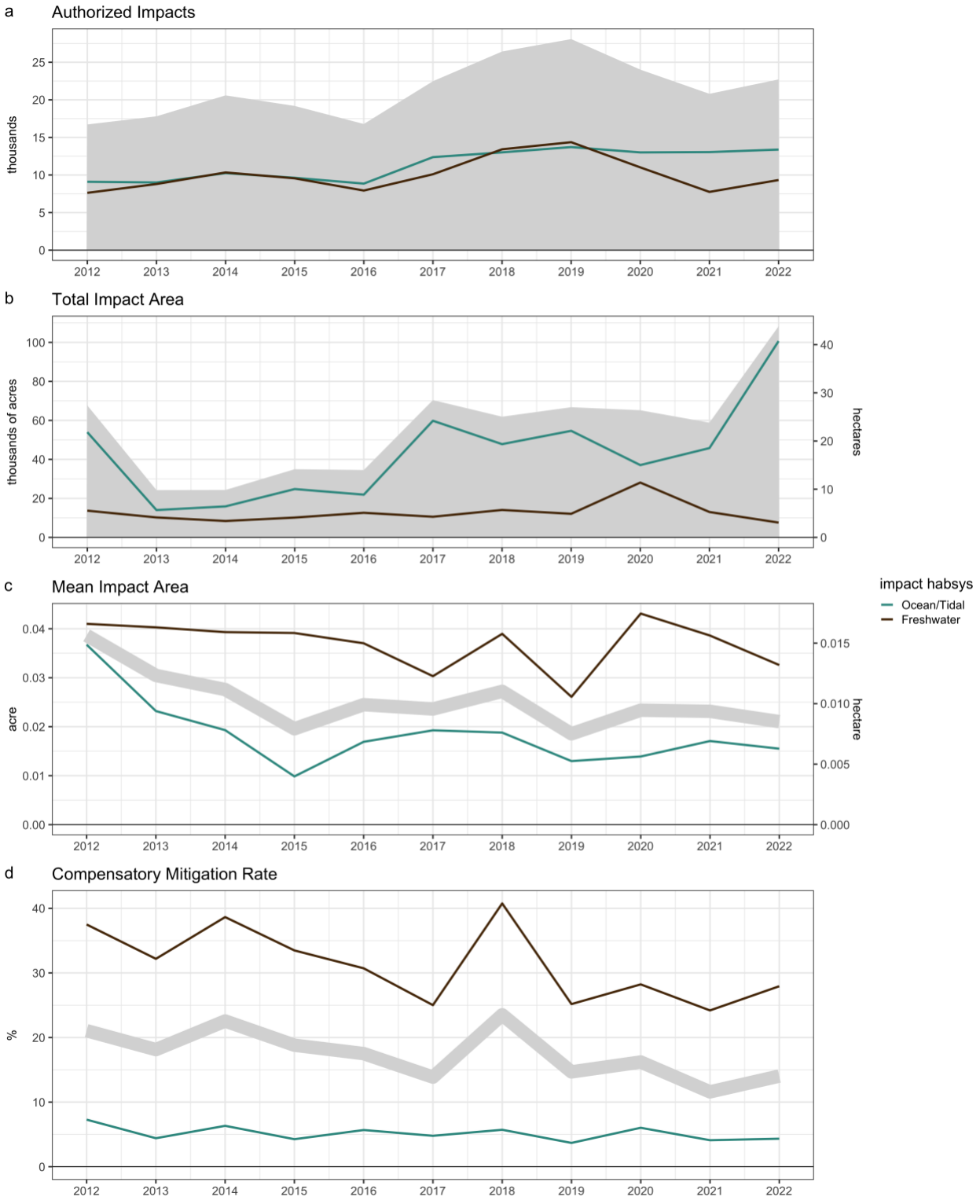

Figure 3-2: Annual impacts authorized in coastal counties from 2012-2022. (a) Number of impacts authorized. (b) Total area impacted. (c) Geometric mean of impact area. d) Rate at which compensatory mitigation is required. Note: Light grey shading indicates the value for both systems combined.

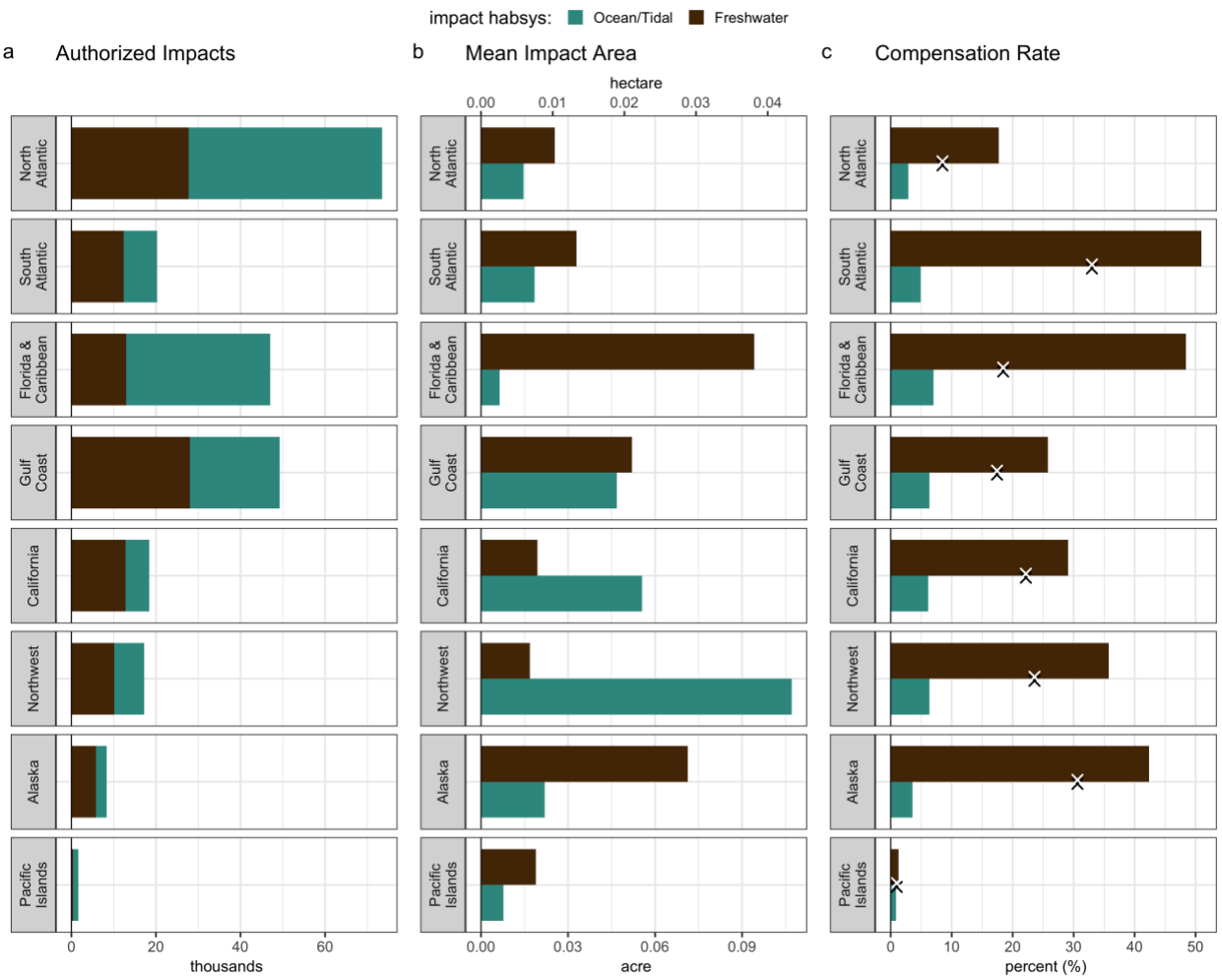

Figure 3-3: Comparison of the number of impacts authorized in coastal counties from 2012-2022 across Corps Districts. Regions are arranged from the North Atlantic, clockwise to Alaska and then out to the Pacific Islands. (a) Number of impacts authorized. (b) Geometric mean of impact area. (c) Rate at which compensatory mitigation is required. An "X" indicates the overall compensatory mitigation rate by region.

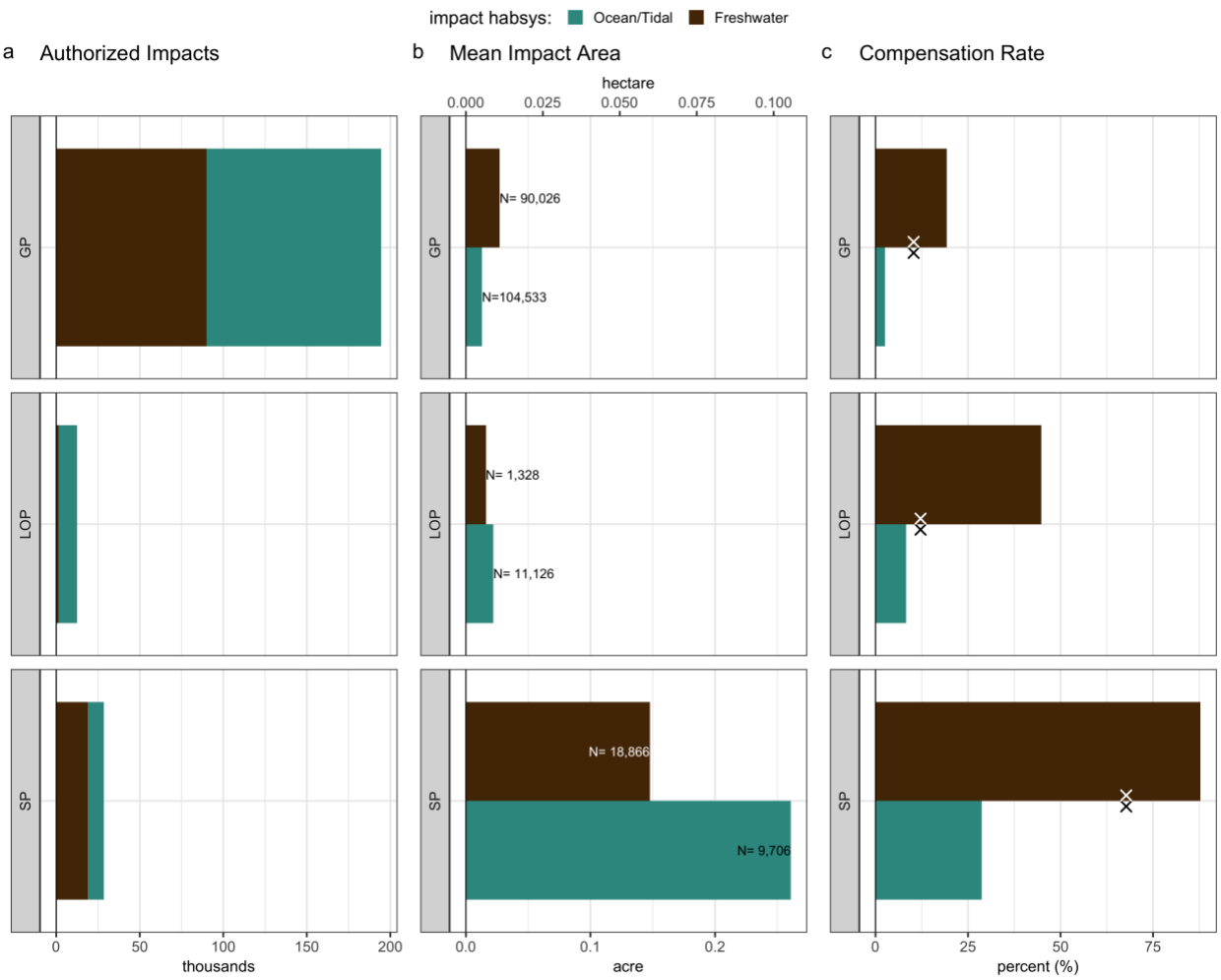

Figure 3-4: Comparison by permit type of authorized impacts in coastal counties from 2012-2022. GP = 'General Permit', LOP = 'Letter of Permission', SP = 'Standard Permit'. (a) Number of impacts authorized. (b) Geometric mean of impact area. (c) Rate at which compensatory mitigation is required. An "X" indicates the overall compensatory mitigation rate by permit type. Filled circles indicate the overall compensatory mitigation rate for the aquatic system.

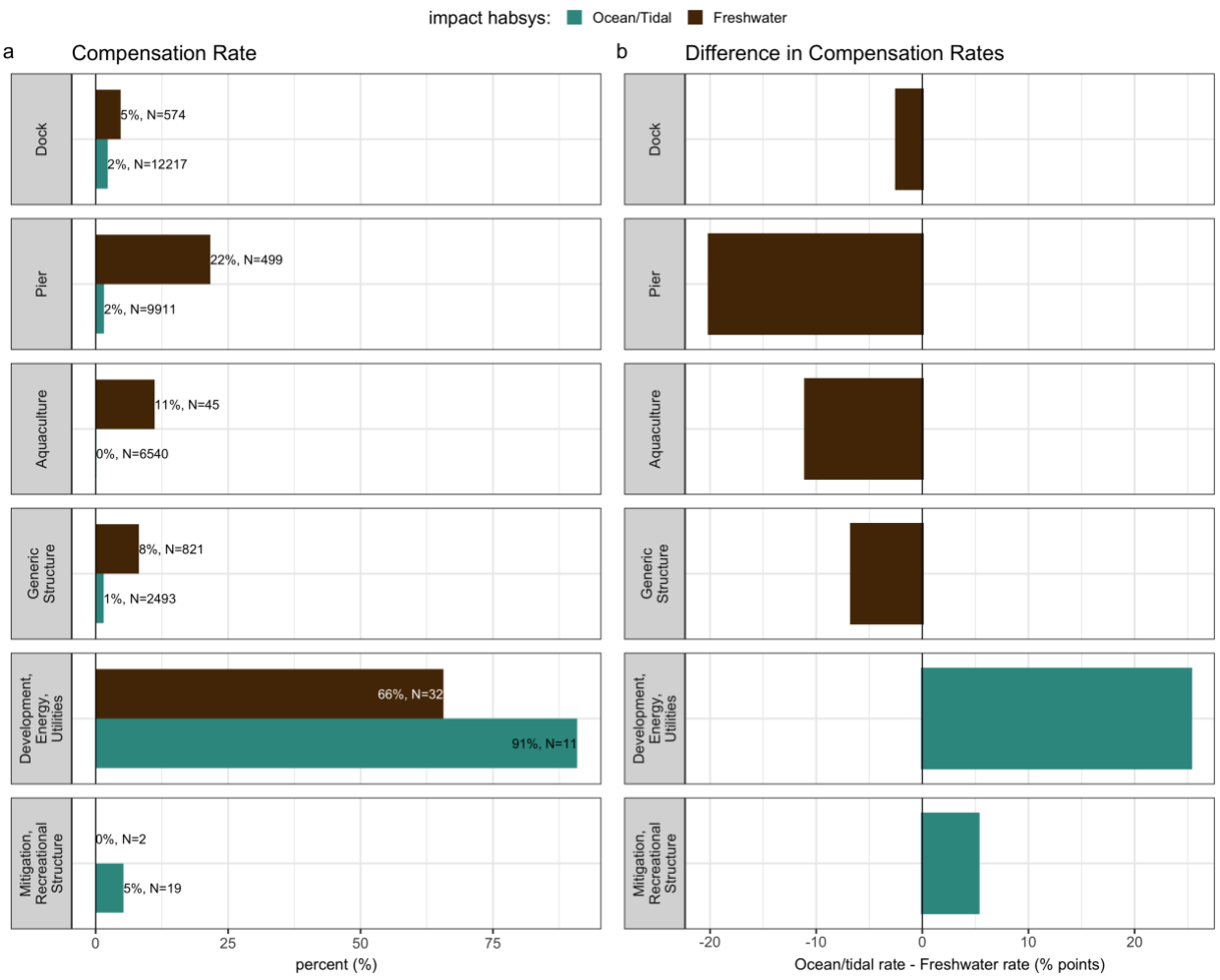

Figure 3-5: Compensatory mitigation for work types that were the two most common, most impactful, or had the highest mean impact size in ocean/tidal systems. (a) Rate at which compensatory mitigation is required. (b) The difference in compensatory mitigation rates between ocean/tidal and freshwater systems.

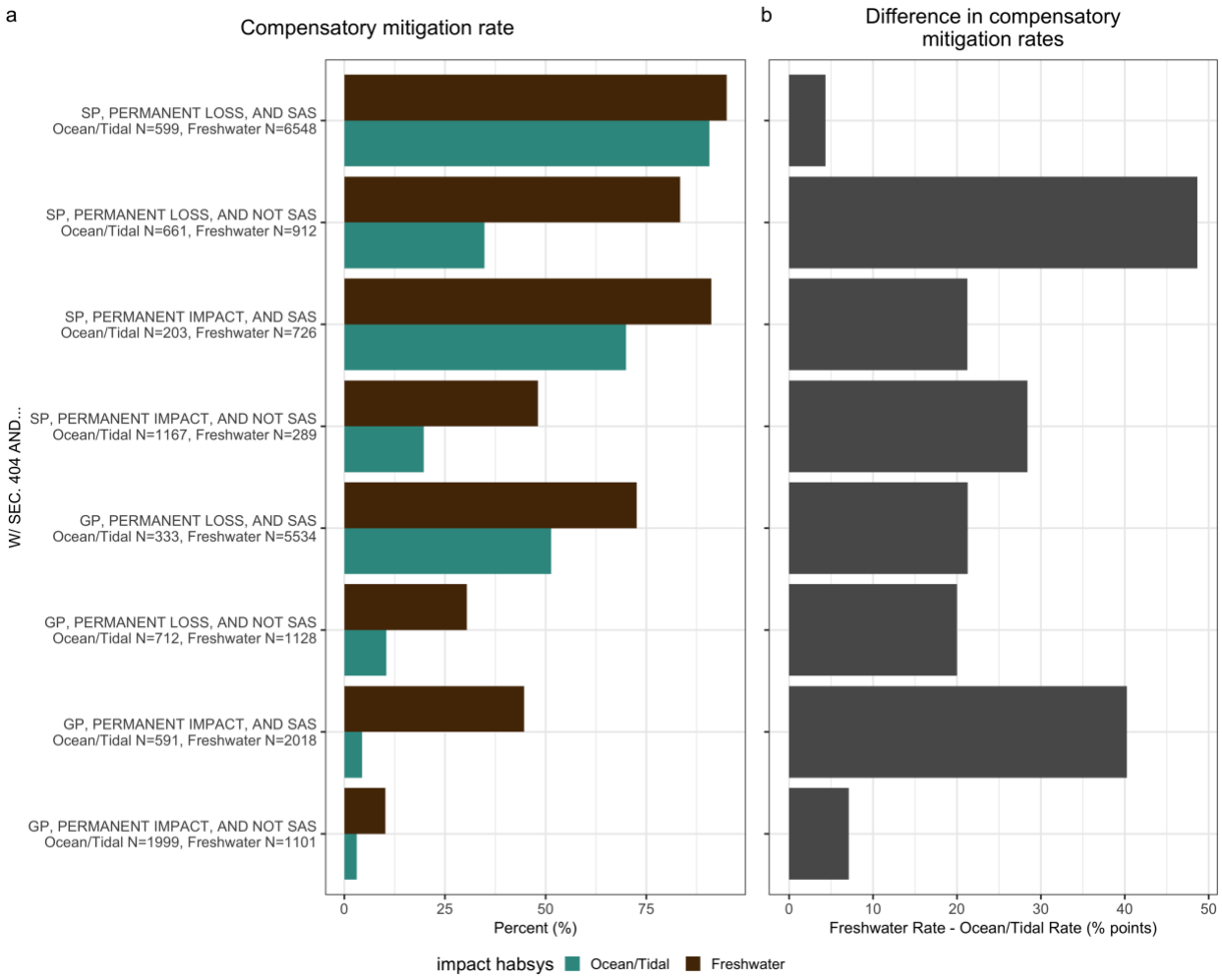

Figure 3-6: Difference in compensatory mitigation rates across select patterns with ocean/tidal and freshwater impacts authorized using Section 404. In all cases, freshwater compensation rates are higher than ocean/tidal rates. Patterns with temporary impacts are not shown. Consistent with the second model, all the impacts are adverse and greater than 0.03 acre of stream bed or 0.1 acre of other water types.

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Appendix 3A: The Corps' Geographic Jurisdiction

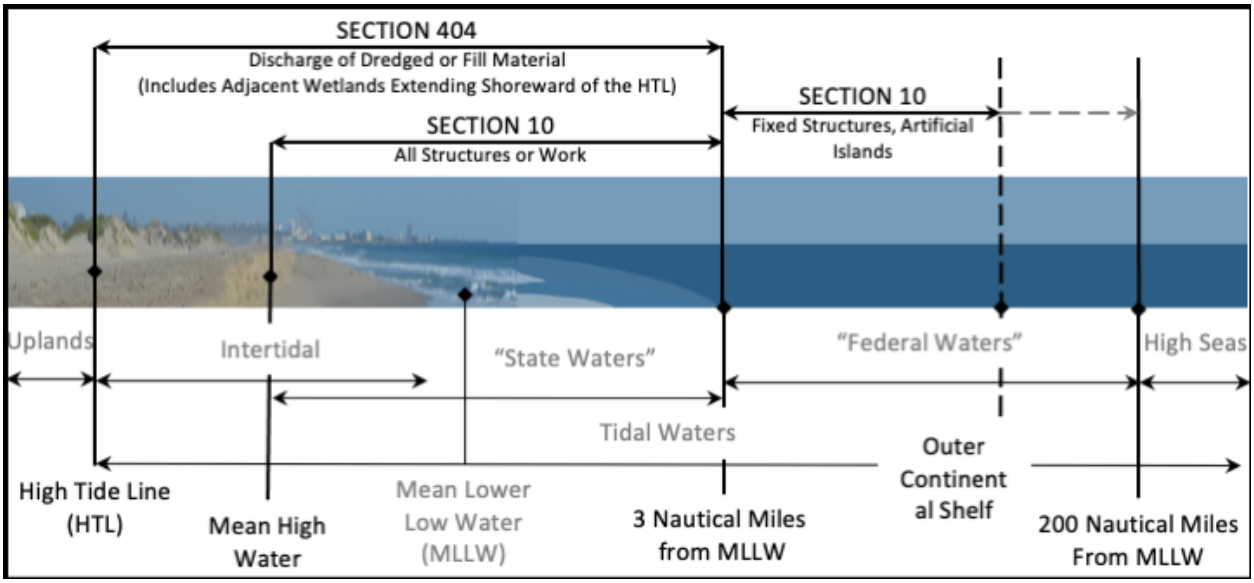

Figure 3-7: Depiction of the geographic extent of the Corps' jurisdiction under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act in ocean and tidal waters.

Appendix 3B: Regions by Corps District and Division

Table 3-4: Relationship between the Region, District, and Division fields in the dataset.

Region	Division	District	State
Alaska	POD	POA	AK
California	SPD	SPK, SPL, and SPN	CA
Florida & Caribbean	SAD	SAJ and SAM	FL, PR, and VI
Gulf Coast	MVD, SAD, and SWD	MVK, MVN, SAM, and SWG	LA, MS, AL, and TX
North Atlantic	NAD	NAB, NAE, NAN, NAO, and NAP	DC, DE, MD, VA, CT, MA, ME, NH, NY, RI, NJ, and PA
Northwest	NWD	NWP and NWS	OR and WA
Pacific Islands	POD	POH	AS, GU, HI, and MP
South Atlantic	SAD	SAC, SAS, and SAW	GA, NC, SC, and VA

Appendix 3C: Work Type for Artificial Reef Projects

Table 3-5: Project descriptions of impacts with the work type 'Mitigation, Recreational Structure'. Notes: 'Count' means the number of impacts authorized., 'Total' means the total area impacted. in acres, and 'Mean' refers to the average impact size in acres per impact.

Project Description	Total	mean
"Construct a new 131-foot long (125 feet overwater) single-use pier, ramp and float consisting of a 4-foot by 67-foot timber pier with 100-percent grated surface, a 3-foot by 40-foot aluminum ramp with 100-percent grated surface, and an 8-foot by 30-foot float with 50-percent grated surface. The pier would be supported by six 8-inch steel piles and the float would be secured with four 10-inch steel piles. Four float stops and two 3-inch steel stub piles would prevent the float from grounding. Additionally, a mooring buoy with a helical screw anchor and midline float system would be installed 305 feet waterward of Mean Higher High Water (MHHW) at a depth of -8.6 feet relative to Mean Lower low Water (MLLW). Mitigation would occur offsite and include the removal of seven full length creosote piles and 93.5 square feet of solid decked pier in the lower Shore zone (LSZ)."	0	0
"The Delaware Department of Natural Resources and Environmental Control has will continue placement of artificial reef materials within the fourteen (14) previously authorized sites in the Atlantic Ocean, Delaware Bay and Delaware River. The artificial reef materials fit into two (2) categories. The first category includes specifically engineered reef habitat structures (designed reef structures). These structures are typically designed to maximize surface area for attached epifaunal organisms and to provide specific habitat requirements for targeted fish species. Designed reef structures can be manufactured to maximize specific marine resource values, making them ideal for reef creation. The second category of artificial reef materials are identified as materials of opportunity. Certain materials of opportunity have been identified as suitable for construction of artificial reef structures including such materials as concrete, rock, surplus ships, barges, tanks, and other armored personnel carriers. Materials of opportunity are also referred to as ¿Secondary Use¿ materials. In accordance with the State Artificial Reef Management Plan, National Artificial Reef Plan and Department of the Army authorizations, all secondary use materials would be required to be properly cleaned, dismantled where necessary, and inspected prior to deployment to assure that they are clean and free of contaminants. "	8,467	605
"The applicant proposes to create a160-acre artificial reef in the GOM. Pre-fabricated reef structures, concrete culverts, obsolete oil and gas structures, obsolete or surplus vessels and other approved artificial reef material may be used. All floatable material will be removed prior to placement. All tanks and compartments will be cleaned to EPA standards prior to placement. The structure will be located greater than 10.7 nautical miles away from any safety fairway, at least 1000 feet away from any active pipelines, and will have at least a 30-foot clearance over the structure."	49	49
"The project is to continue construction for the next ten (10) years within the existing Oleta Inshore Artificial Reef; specifically, to strategically deploy and/or anchor approved artificial reef material (as acquired) within the available 5.09 acres of the aforementioned site. The permittee will place a maximum of 35,000 cubic yards (y^3) (3,500 y^3 annually) of clean material over the life of the permit (10yrs). The work shall maintain a minimum of 6 feet vertical clearance from Mean Low Low Water Line (MLLWL) to the top of any deployed structure. Deployment at this site will be limited to less than 5.09 acres due to the existing reefs and necessary deployment buffers areas. The Permittee, Miami-Dade County DRER-DERM, will be responsible for the continual monitoring and maintenance of the site and all work areas that are in/over waters of the United States."	5	5
"Construct a new visitor center for the Redwood National and State Park, establish a Yurok Demonstration Site, construct new recreational trails, and perform onsite stream and wetland restoration in Prairie, Skunk Cabbage, and Libby Creeks"	6	3
"Two shoreline boardwalk projects and associated debris removal"	1	0

Appendix 3D: Model Results

Covariance Tables

Table 3-6: Covariance table for model 1. The highest covariance rate (0.613) occurs between "Loss to Permanent impact" and "Permanent impact to Temporary."

Predictor	Above to Below Threshold	SP to LOP	LOP to GP	SAS to Not SAS	Loss to Permanent impact	Permanent to Temporary Impact
Above to Below Threshold	1.000	-0.107	-0.261	-0.145	-0.040	0.119
SP to LOP	-0.107	1.000	0.423	-0.050	-0.074	-0.080
LOP to GP	-0.261	0.423	1.000	0.004	-0.100	-0.141
SAS to Not SAS	-0.145	-0.050	0.004	1.000	-0.067	-0.080
Loss to Permanent impact	-0.040	-0.074	-0.100	-0.067	1.000	0.613
Permanent to Temporary Impact	0.119	-0.080	-0.141	-0.080	0.613	1.000

Table 3-7: Covariance table for model 2. The highest covariance rate (0.369) between "Temporary to Permanent impact" and "Permanent impact to Loss."

Predictor	Ocean/Tidal to Freshwater	Temporary to Permanent impact	Permanent impact to loss	Not SAS to SAS	GP to LOP	LOP to SP	Sec. 10 to w/ Sec. 404
Ocean/Tidal to Freshwater	1.000	0.107	-0.018	-0.288	0.088	0.243	-0.113
Temporary to Permanent impact	0.107	1.000	0.369	0.109	0.034	0.010	0.103
Permanent impact to loss	-0.018	0.369	1.000	0.103	0.052	0.027	-0.026
Not SAS to SAS	-0.288	0.109	0.103	1.000	0.154	0.315	-0.058
GP to LOP	0.088	0.034	0.052	0.154	1.000	0.192	0.313
LOP to SP	0.243	0.010	0.027	0.315	0.192	1.000	-0.005
Sec. 10 to w/ Sec. 404	-0.113	0.103	-0.026	-0.058	0.313	-0.005	1.000

Results of Wald Test of Differences

Table 3-8: Results of the Wald test of differences in coefficients in model 1.

Coefficients compared	Chi2	df	p.value	Signif.
mit_thresholdBelow and permit_typeLOP	1,836.83	1	0.0e+00	*
mit_thresholdBelow and permit_typeGP	222.45	1	0.0e+00	*
mit_thresholdBelow and impact_sas_binaryNot SAS	9,513.64	1	0.0e+00	*
mit_thresholdBelow and duration_levelPermanent impact	6,998.62	1	0.0e+00	*
mit_thresholdBelow and duration_levelTemporary	743.73	1	0.0e+00	*
permit_typeLOP and permit_typeGP	1,674.07	1	0.0e+00	*
permit_typeLOP and impact_sas_binaryNot SAS	5.10	1	2.4e-02	
permit_typeLOP and duration_levelPermanent impact	2.23	1	1.4e-01	
permit_typeLOP and duration_levelTemporary	945.17	1	0.0e+00	*
permit_typeGP and impact_sas_binaryNot SAS	4,870.02	1	0.0e+00	*
permit_typeGP and duration_levelPermanent impact	3,011.88	1	0.0e+00	*
permit_typeGP and duration_levelTemporary	27.73	1	1.4e-07	*
impact_sas_binaryNot SAS and duration_levelPermanent impact	60.80	1	6.3e-15	*
impact_sas_binaryNot SAS and duration_levelTemporary	5,047.73	1	0.0e+00	*
duration_levelPermanent impact and duration_levelTemporary	8,890.10	1	0.0e+00	*

**Significant with 99% confidence (p < 0.01)*

Table 3-9: Results of the Wald test of differences in coefficients in model 2.

Coefficients compared	Chi2	df	p.value	Signif.
impact_habsysFreshwater and duration_levelPermanent impact	134.28	1	0.000	*
impact_habsysFreshwater and duration_levelPermanent loss	235.43	1	0.000	*
impact_habsysFreshwater and impact_sas_binarySAS	80.59	1	0.000	*
impact_habsysFreshwater and permit_typeLOP	7.41	1	0.006	*
impact_habsysFreshwater and permit_typeSP	704.56	1	0.000	*
impact_habsysFreshwater and permit_auth_binaryw/ Sec. 404	0.00	1	0.979	

**Significant with 99% confidence (p < 0.01).*
Comparisons not involving "impact_habsys" not shown.

Goodness of Fit

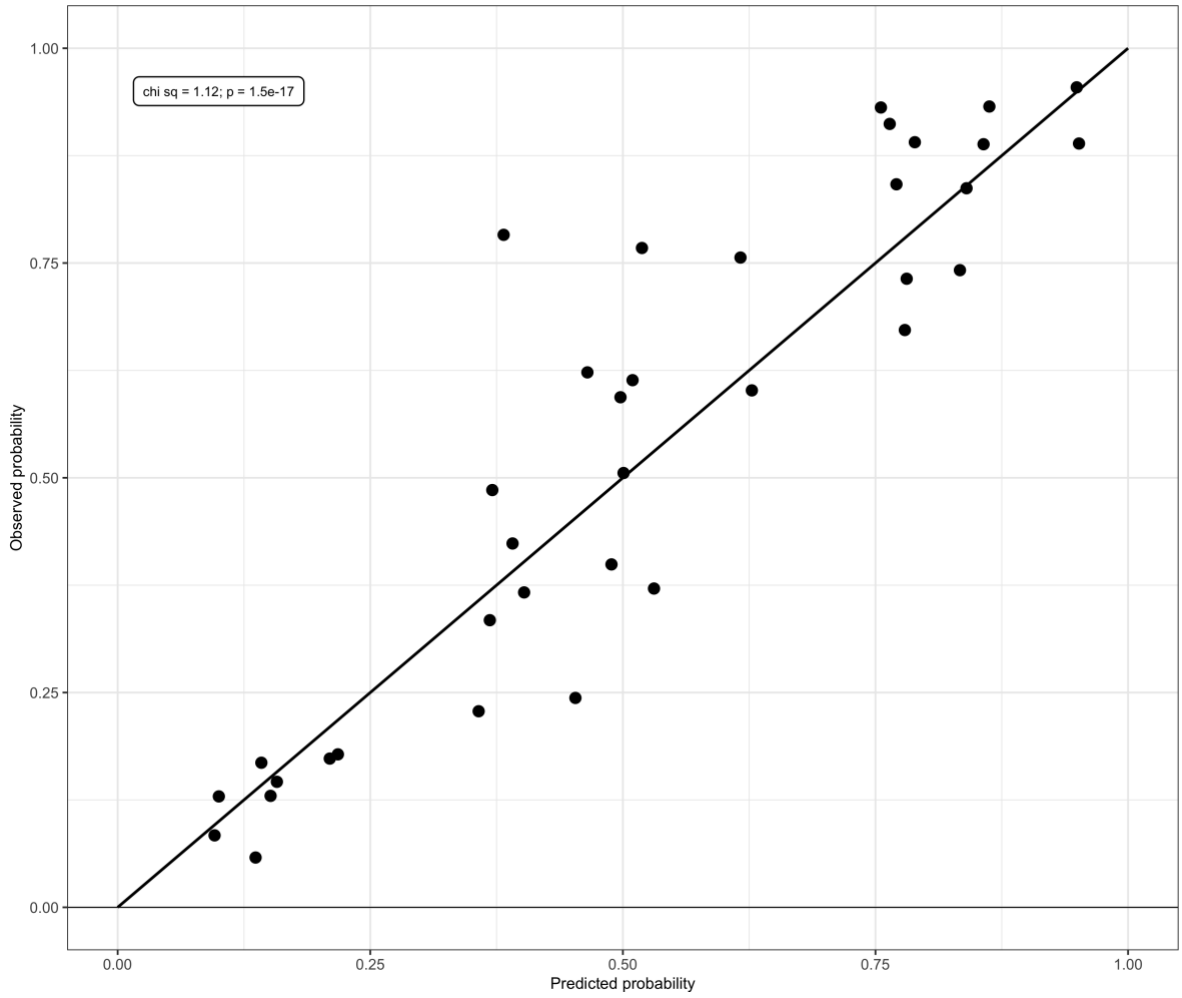

Figure 3-8: Observed versus predicted probabilities for model 1. Comparison of the observed probability that the impacted system was ocean/tidal or freshwater with the probability as predicted by the four variables describing the Corps' criteria for when to require compensatory mitigation. Each point represents a unique combination of the predictive variable values (pattern) and the observed or predicted outcome (ocean/tidal or freshwater). All patterns have more than five observations.

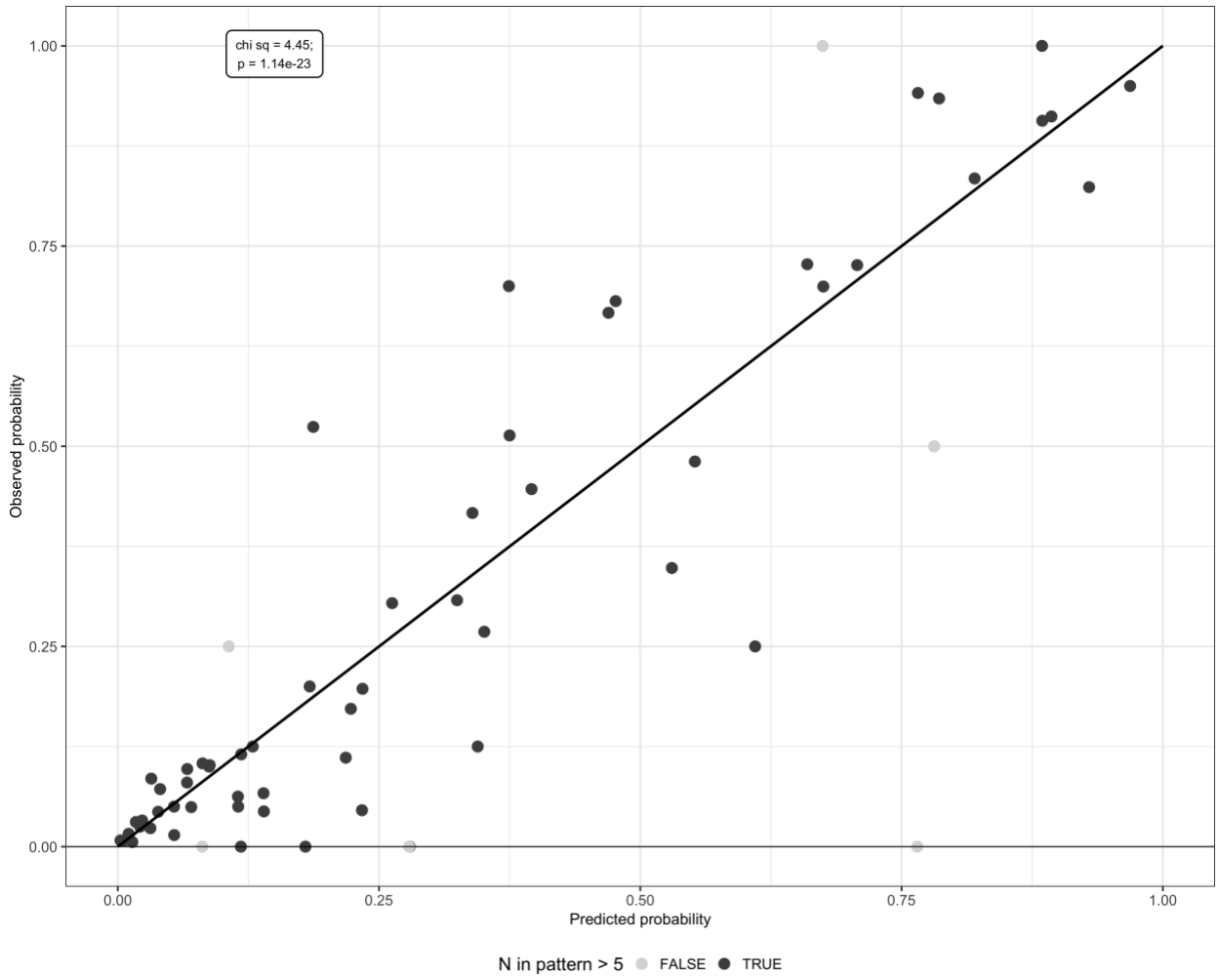

Figure 3-9: Observed versus predicted probabilities for model 2. Comparison of the observed probability that the impacted system was ocean/tidal or freshwater with the probability as predicted by the five variables describing the Corps' criteria for when to require compensatory mitigation and the environmental review process (i.e., permit authority). Each point represents a unique combination of the predictive variable values (pattern) and the observed or predicted outcome (ocean/tidal or freshwater). Patterns with fewer than five observations in the data are less reliable and are shaded with a lighter gray.

CHAPTER 4: FEDERAL-STATE COORDINATION TO ASSIST SEA LEVEL RISE ADAPTATION IN CALIFORNIA

Abstract

California's coastline is vulnerable to beach and cliff erosion—a risk that will worsen with sea level rise. Hard defenses damage coastal ecosystems, reduce beach recreation opportunities, and reduce the sand supply. The California Coastal Commission and the U.S. Army Corps of Engineers (Corps) both have roles in permitting activities along the coast. This research seeks to identify areas of overlap and misalignment between California's sea level rise adaptation plan and the Corps' permit program. I found the Corps' permitting program to be misaligned with some, but not all, the state's adaptation goals. One area of misalignment is with the Coastal Commission's goal to increase the supply of beach sand by reducing channelization of streams. Another area of misalignment is with the Coastal Commission's goal to remove hard bank stabilization or use bioengineered bank stabilization instead. The Corps used a streamlined permit for 98% of bank hardening and 100% of shoreline armoring projects. I also make recommendations for how the Corps' California Districts can help facilitate sea level rise adaptation by using non-streamlined permits more for new hard bank or shoreline stabilization and streamlined permits for removing hard stabilization or using a nature-based solution instead and increase the efficiency of their programs.

Introduction

> *The coast of the United States is, in many respects, the Nation's most valuable geographic feature. It is at the juncture of the land and sea that the greater part of this Nation's trade and industry takes place. The waters off our shore are among the most biologically productive regions of the Nation.*
>
> *—Stratton Commission (Stratton Commission, 1969)*

The Stratton Commission did not overstate the value of the coastline. Coastal ecosystems are rich in biodiversity, serve as critical habitat for marine wildlife, provide ecosystem services (e.g., food, energy, and water purification), contribute tens of trillions of dollars to the U.S. economy (National Ocean Economics Program, 2021), are important to national security, and are generally desirable places to live. Conflicts between these numerous values and uses began to develop in the 1950s and 60s. In 1972, Congress passed the Coastal Zone Management Act (16 USC 1451-1465), which creates a framework for states to direct and regulate development in the coastal zone. As an inducement, participating states receive dedicated funding and technical assistance from the federal government. In addition, the actions of federal agencies, including permitting decisions, must be consistent with the state's certified coastal zone management program (16 USC 1456(c)).

Preparing California's Coastline for Sea Level Rise

California's coastal zone management program was certified in 1978 (NOAA Office for Coastal Management, 2023). The California Coastal Act of 1976 identifies how the program will be administered, defines the coastal zone, and establishes the state's policy goals for managing coastal development. Three state agencies administer California's coastal program: the California Coastal Commission (Coastal Commission), San Francisco Bay Conservation and Development Commission (BCDC), and the California Coastal Conservancy. The Coastal Commission has jurisdiction over California's Coastal Zone everywhere except the San Francisco Bay. BCDC has jurisdiction over San Francisco Bay and the Coastal Conservancy protects and improves natural lands and waterways through the purchase and restoration of coastal properties. This research will focus on the Coastal Commission because it has a more extensive role in regulating coastal development in the state (C. Lester, 2013).

The coastal zone under the jurisdiction of the Coastal Commission extends seaward three miles ("state waters") and landward 1,000 yards from the mean high tide line with two categories of exceptions: 1) Where there are significant coastal estuaries, habitat, and recreational areas, it extends to the first major ridgeline paralleling the sea or five miles from the mean high tide line, whichever is less; 2) In developed urban areas, it often extends less than 1,000 yards (C. Lester, 2013).

The goals of California's coastal zone management program are to protect and restore the coastal environment, balance the use and conservation of coastal resources, maximize public access and recreational opportunities, prioritize coastal-dependent development on the coast, encourage multi-benefit development and educational use, and plan for and mitigate the adverse environmental and economic effects of sea level rise within the coastal zone (California Coastal Act, Pub. Res. Code § 30001.5).

To implement the program, the California Coastal Act requires development in the coastal zone to receive a Coastal Development Permit from the Coastal Commission (or from a local agency with a certified local coastal program). These permits, when issued by the Coastal Commission, also serve as a consistency certification for federal agencies making permitting decisions.

In 1990, Congress added a requirement to include provisions for the "study and development" of "plans for addressing the adverse effects… of sea level rise" (16 U.S.C. 1452(2)(K)). California's primary risk exposure to sea level rise is flooding of low-lying areas near river mouths, and beach and cliff erosion (Grandpre et al., 2018). Coastal erosion has long been a concern in California. As of 2018, 14% of the state's coastline has been hardened (Griggs & Patsch, 2019). In Southern California the situation is worse, with 38% of the coastline

armored (Griggs & Patsch, 2019). In addition, the primary source of sand for California's beaches: rivers and streams, has also been severely reduced by dams and stream channelization in the upper watershed (Griggs, 2005; Slagel & Griggs, 2008; Willis & Griggs, 2003). Coastal armoring causes other conflicts with the goals of the Coastal Act, including the reduction of beach access (Griggs, 2005, 2010).

While the Coastal Commission recognizes the harm hard stabilization can cause to coastal resources, the Coastal Act provides a pathway for their approval "when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply" (California Coastal Act, Pub. Res. Code § 30235). Starting in 2014, however, the Coastal Commission began to work harder to only authorize hard shoreline stabilization in those specific circumstances (Grandpre et al., 2014). This preference to limit the use of hard shoreline stabilization, was incorporated into official Sea Level Rise Policy Guidance in 2015 (Coastal Commission Guidance) (CCC, 2018b).

In 2017, the California Ocean Science Trust released the "Rising Seas in California" report, which provided guidance on the methods and approach state agencies should use to incorporate sea level rise projections into their decision making (Griggs et al., 2017). Following this, the Ocean Protection Council published their Sea-Level Rise Guidance in 2018. The Ocean Protection Council's Guidance established sea level rise projections for California's 12 tide-gauge stations (OPC, 2018). In 2018, following the release of these technical guidance documents, the Coastal Commission updated their policy guidance to incorporate more recent sea level rise projections (CCC, 2018b).

Chapter 7 of the Coastal Commission Guidance (CCC, 2018b) identifies three overarching adaptation strategies: protect, accommodate, and retreat. Protection strategies refer to efforts to defend development or other resources in their current location using either "hard" or "soft" measures. Accommodation strategies refer to efforts to modify existing developments or design new developments in ways that increase the resiliency of the development to impacts of sea level rise. Retreat strategies refer to the relocation or removal of existing development from hazard areas and limit the construction of new development in vulnerable areas.

The Coastal Commission Guidance is organized into seven topic areas (A-G). Each topic contains several goals with respect to sea level rise adaptation. Under each goal is a set of specific adaptation strategies related to that goal. For example, under the "Coastal Development and Hazards" topic, there are nine goals. One of these goals is "Allow bluff and shoreline protective devices only to protect existing endangered structures." Under this goal the document describes 12 specific adaptation strategies and sub strategies. One of these strategies is "Use hard protection only if allowable and if no feasible less damaging alternative exists." The other topics are "Public Access and Recreation," "Coastal Habitats, ESHA, and Wetlands," "Agricultural Resources," "Water Quality and Supply," "Archaeological and Paleontological Resources," and "Scenic and Visual Resources."

The Coastal Commission Guidance is aspirational–its purpose is to serve as a guide for local jurisdictions, state agencies, and private owners of property within the state's coastal zone, particularly when planing for the future. Nonetheless, the goals espoused therein establish road-markers by which progress toward these goals can be measured.

Federal Consistency in the Coastal Zone

Most construction activities seaward of the high tide line require a permit from the Corps (33 U.S.C. 403 of 1899 as amended and 33 U.S.C. 1344 of 1972 as amended). If that activity is within the Coastal Zone, the Corps cannot issue its permit (for discharges of dredged or fill material or structures and work) until the project has received a federal consistency certification from the Coastal Commission. Therefore, the project proponent must get a permit from the Corps in addition to a Coastal Development Permit. If the Coastal Development Permit is issued by the Coastal Commission, it also serves as the federal consistency certification. If the Coastal Development Permit is issued by a local jurisdiction, then the project proponent must get a separate consistency certification from the Coastal Commission.

Despite the different objectives of the Coastal Act, the Clean Water Act, and the Rivers and Harbors Act, there are some similarities between the two programs. For example, both must conduct thorough environmental reviews for projects with significant effects on the resources they regulate. Both programs also seek to make balanced permitting decisions within the constraints of the respective regulatory authority. The Coastal Commission Guidance recognizes that each project is unique and must be analyzed on a case-by-case basis against the standards of the Coastal Act. Similarly, the Corps' permit decisions are also analyzed on a case-by-case basis against the standards of the Clean Water Act and the Rivers and Harbors Act. Finally, in both cases, the workload of each agency reflects decisions made by private property owners. There is one big difference that I will exploit in this report. The Coastal Commission can use planning tools to guide changes in coastal development through the approval of local coastal plans, whereas the Corps Regulatory Program does not have a similar authority. The only way the Corps' program can encourage behavior change is by streamlining the permitting process for certain activities.

The Corps issues three types of permits: General Permits authorize categories of activities that have no more than *minimal* individual and cumulative adverse environmental effects (33 U.S.C. 1344(e)). Letters of Permission are a type of individual permit that is processed using alternative, less time consuming, procedures applied to categories of *minor* activities (can be more than minimal) that would not have significant individual or cumulative impacts on environmental values and should encounter no appreciable opposition (33 CFR 325(e)(1)). Standard Permits are also a type of individual permit and are used for activities that do not qualify for another type of permit or are likely to have more than minor adverse effects on the environment.

General Permits include limits on the size of the impacts that can be authorized as a way of ensuring the effects are no more than minimal. Because General Permits require substantially less time to process than individual permits, applicants have a strong incentive to design their projects within the limits of a General Permit (USACE, 2021, p. 73523). Some General Permits also have approvals from other state and federal agencies, increasing the incentive to qualify for the General Permit. However, the Coastal Commission has never provided a consistency certification for one of the Corps' General Permits. If the General Permit does not come front-loaded with a needed approval from another agency, then the applicant must obtain these associated permits separately before the Corps can authorize the activity, which marginally degrades the efficiency benefits of the General Permit for project proponents.

For example, Nationwide Permit 13 for Bank Stabilization authorizes any kind of stabilization of a bank, including shorelines, so long as the length of bank is less than 500 linear feet. Under certain circumstances this permit can even be used without notifying the Corps. However, the hard stabilization allowed under Nationwide Permit 13 is in opposition to many of the sea level rise strategies identified in the Coastal Commission Guidance and has been

criticized for authorizing the "the inevitable destruction of miles of coastal wetlands" (Brandon, 2016; see also Brandon, 2019). In 2017, the Corps also issued a new Nationwide Permit for "living shorelines" (NWP-54), which is one of the softer solutions to coastal erosion encouraged by the Coastal Commission. This permit always requires review by the Corps and is only applicable in tidal waters. There is no comparable General Permit for bioengineered bank stabilization.

Research Questions

These examples raise two questions: 1) Are there other examples in which the Corps' General Permits are "incentivizing" activities that are discouraged by the Coastal Commission? 2) Are there other areas in which the Corps could add conditions to existing General Permits or author new ones for categories of activities that are encouraged by the Coastal Commission, which could receive categorical consistency certification, thereby "incentivizing" these types of projects?

This research aims to understand how the Corps' permitting intersects with California's sea level rise adaptation goals and how streamlined permitting could be used to encourage desirable activities, or, in their absence, discourage them. The approach I take is to 1) characterize the Corps' permitting in the California's coastal zone in relation to the Coastal Commission Guidance, and 2) compare the use of the Corps' permit types with the Coastal Commission Guidance to identify actions that the Coastal Commission would like to encourage but which *were not* authorized by streamlined permits and, alternatively, actions that the Coastal Commission would like to discourage but which *were* authorized with streamlined permits.

Methods

Data and Software

I obtained data for permits issued or verified between 1 January 2012 and 31 December 2022 for all Corps Districts with a maritime coastline through a FOIA request submitted to the Corps on 10 January 2023. The data come from information entered about permit applications by the Corps Regulatory Project Managers into the OORM2 database. All data organization, processing, and analysis steps were performed using R (v4.3.0, R Core Team, 2022) run in RStudio. Chapter 2 describes the data and initial cleaning process in more detail. The raw and processed data are available here: ***https://doi.org/10.5061/dryad.jwstqjqgn***. Each observation in the resultant dataset represents a single impact authorized by the Corps. Multiple impacts may be associated with a single coastal development project.

I also obtained the following geospatial data to assist my analysis: a shapefile of the Coastal Commission's coastal zone (CCC, 2014) and shapefiles of cliff and shore baseline and erosion projections for 25, 150, and 250 cm, (0.8, 4.9, and 8.2 feet (ft), respectively) of sea level rise from the Coastal Storm Modeling System (CoSMoS) for Northern California (Barnard et al., 2022), Central California (Barnard et al., 2018a), and Southern California (Barnard et al., 2018b). I also accessed The Nature Conservancy's Flood and Sea Level Rise App (TNC app, The Nature Conservancy, 2021) to find additional locations potentially at risk using their 1 ft (30.5 cm) and 5 ft (152 cm) projections. Note, in this chapter, I use metric units to be consistent with standard practice in the field.

I chose the above scenarios based on the recommendations and sea level rise projections in the Coastal Commission Guidance (CCC, 2018b, Ch. 6G). Chapter 6 of the Coastal

Commission Guidance says to consider the lifespan of the development first and the level of risk appropriate for that type of development when selecting sea level rise scenarios to evaluate a project's potential exposure to hazards. Projects with a short lifespan can use projections over a shorter time horizon (e.g., 25 years). Projects with a long lifespan should use projections over a longer time horizon (e.g., 100 years or more). An unpaved section of the coastal trail would be an example of a project with a short lifespan and low consequences. An example of a project with a long lifespan and high consequences would be a wastewater treatment plant. For simplicity and due to limited level of detail in the Corps' permit data, I only used the following three most common combinations of lifespan and risk aversion: low-low, medium-medium, and high-high.

I used the sea level rise projections provided in Appendix G, which contains low, medium-high, and extreme sea level rise projections for every coastal county in California (CCC, 2018b, Ch. 6). Averaged over all counties, these projections are for 28 cm (0.9 ft) of sea level rise for the low-risk, 25-year scenario; 182 cm (6 ft) of sea level rise for the medium-high-risk, 75-year scenario; and 218 cm (7 ft) of sea level rise for the medium-high-risk, 100-year scenario. The CoSMoS projections that aligned with these risk-based scenarios and were also available across all regions were for 25, 150, and 250 cm of sea level rise.

I converted the CoSMoS data into spatial polygons using the R package, "sf" (v1.0.12, Pebesma et al., 2023) and used the "st_contains" function to identify whether the projects authorized by the Corps (spatial points) were in hazard areas (spatial polygons). To create the "at risk now" polygon, I applied a 12.2-m (40-ft) buffer around the cliff or shore baseline. I arrived at a 12.2 m buffer based on the legal arguments in Martin v. California Coastal Com. (2021), which used 12.2 m as a standard required distance new development should be set back from the cliff edge. I also created a polygon for each sea level rise scenario from the base shore

or cliff line and respective sea level rise scenario. To create the polygons from the CoSMoS point data, the points needed to be ordered sequentially according to their spatial orientation. In most cases, the points were numbered sequentially in their spatial order. However, the baseline points for the Southern California shore erosion data were not numbered sequentially and therefore could not be used in my analysis given time constraints. For the Southern California dataset only, I used the 25 cm line as the baseline for the 150 cm and 250 cm scenarios, a 24.4 m buffer around the 25 cm projection for the 25 cm scenario, and a 12.2 m buffer around the 25 cm projection for the "at risk now" scenario.

Data Processing

Using the cleaned dataset containing the Corps' permitting information, I extracted only those impacts occurring in the state of California and within the Los Angeles and San Francisco Districts. These Corps Districts are the only two whose area of responsibility overlaps with the Coastal Commission's coastal zone. Los Angeles District's area of responsibility along the coast extends from the U.S.-Mexico border to the San Luis Obispo-Monterey County boarder. San Francisco District's area of responsibility along the coast extends from Los Angeles District's northern border to the California-Oregon border. In Microsoft Excel, I manually reviewed, and corrected as needed, the coordinates for every observation. Then, in R, I used the coastal zone shapefile to identify impacts located in the Coastal Commission's coastal zone, I used the 8-digit Hydrologic Unit Code (HUC) to identify impacts located in a watershed that drains through the coastal zone, and I used the CoSMoS shapefiles to add fields indicating whether the impact site was contained within which CoSMoS sea level rise scenario. After eliminating impacts occurring in watersheds that do not drain through the coastal zone, impacts to uplands, and temporary impacts, I exported the data out of R for further processing.

Identifying risk by project type

In Excel, I reviewed every impact to determine the risk at the impact location according to four categories: hazard area, long term risk, subtidal, and not at risk. “Hazard area” indicates a project site that is seaward of the appropriate sea level rise projection or meets the Coastal Commission’s definition of “at risk now” (i.e., the development already is protected by hard shoreline stabilization) found in the Coastal Commission Guidance (CCC, 2018b, pg. 133, A.12f). “Long term risk” indicates a project site that is landward of the appropriate sea level rise projection but is seaward of a more risk-averse scenario (e.g., coastal recreation facilities outside of the 25 cm projections for sea level rise but within the 150 or 250 cm projections). “Subtidal” indicates projects that are entirely subtidal (e.g., undersea cables and dredging of navigational channels). “Not at risk” indicates the project is landward of all sea level rise scenario projections and was not subtidal.

To save time, I used information about the specific General Permit used to authorize the project to identify most subtidal impacts. Specifically, if the permit used was one of the following it was automatically coded as subtidal: NWP-48: Commercial Shellfish Mariculture Activities, NWP-09: Structures in Fleeting and Anchorage Areas, NWP-28: Modifications of Existing Marinas, NWP-01: Aids to Navigation, NWP-36: Boat Ramps, and NWP-04: Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities. Additional subtidal sites were identified when the coordinates and the project description confirmed a subtidal location.

To identify hazardous areas, I first looked at the appropriate CoSMoS projection (baseline and 25, 150, or 250 cm of sea level rise) or TNC projection (baseline, and 30.5 or 152 cm) for the development. For example, when using the CoSMoS projections, I used the 25 cm projections for coastal recreational facilities, I used the 250 cm projections for critical

infrastructure including transportation projects, and for everything else I used the 150 cm projections. This resulted in only 65 projects as located in a hazard area out of 969 projects in the coastal zone, which seemed an under-representation and possibly due to how Corps project locations are specified. To identify additional project sites in potentially hazardous areas, I also used the TNC App. The TNC App did not have projections beyond 152 cm (5 ft). When using the TNC projections, I used the 30.5 cm projections for coastal recreational facilities and the 152 cm projections for everything else. I checked Google Earth's historic satellite imagery to see if a project was protected by hard shoreline stabilization at the time the permit was authorized. I also looked at the project description to see if it described a situation (i.e., new shoreline stabilization in response to shoreline erosion threatening the stability of a building) indicating the building is at risk of coastal erosion. The "location reason" field tracks which "definition" of hazard area I used to categorize each permit action. Table 4-1 shows the number of projects that fell in each risk category by each method of determining risk.

Relating projects to the Coastal Commission Guidance

I used a nested categorization scheme to categorize the projects from the Corps' database and relate these projects to the Coastal Commission Guidance. The first level extracted components of the strategies from the Corps' permit data. These components were: Purpose (loosely related to topic area), Project (e.g., a building, shoreline stabilization, etc.), Construction Type (e.g., new, maintenance, upgrade, etc.), and Situation (e.g., emergency or planned). For example, for a permit in which a residential property owner was authorized to replace a failing seawall with a new one to meet current building codes, and to add a cantilevered deck to the top of the new seawall, the Purpose would be "private development," the Project would be "hard shoreline stabilization and development," the Construction Type would

be “replace the hard shoreline stabilization” *and* “upgrade the development,” and the Situation would be “planned.”

The second level, the Recommended Action, characterizes how the project relates to the advice in the Coastal Commission Guidance according to the following levels: prohibit, avoid, limit, contrary, conditional, neutral, allow, complementary, encourage, not addressed, and not regulated. I assigned the Recommended Action based on the extracted components described above and the location in relation to a hazard area (Risk). I found it easier to evaluate projects by grouping the relevant strategies under their respective goals. For brevity, I gave each group of strategies a name drawn from the respective goal. For example, strategies A.12b (“Limit redevelopment or upgrades to existing structures in at risk locations”) and A.12f (which states “improvements to that [currently at risk] structure in its current location may be limited”) are grouped in the Coastal Commission Guidance under the goal: “Incorporate sea level rise adaptation into redevelopment policies.”) I named this grouping of strategies “Existing Development.”

Then, I compared the information about the project with the descriptions under the strategies, characterized the relationship, and added a reference to the relevant goal. Continuing with the previous example for the “Existing Development (A.12)” goal, I characterized projects to replace, renovate, upgrade, or expand existing development in hazardous areas of the coastal zone as “avoid,” while I characterized projects to only maintain existing development in hazardous areas as “neutral.” I characterized upgrades to development in long term risk areas as “allow” to reflect that the risk in likely outside the temporal range of what would be used to assess that project.

For the above example, the project relates to Strategy A.12: "Avoid the expansion or perpetuation of existing structures in at-risk locations." Because the property is already protected by hard shoreline stabilization, it is in an "at-risk now" location and, therefore, the Recommended Action is "avoid."

Not every strategy in the Coastal Commission overlapped with the projects found in the Corps' database and not every project in the Corps' database matched with a strategy in the Coastal Commission. Projects outside of the coastal zone that were not related to the Coastal Commission Guidance in any way, such as non-water quality, non-stormwater management projects, were coded as "not regulated." Activities not related to the Coastal Commission Guidance at all but still regulated by the Coastal Commission, such as deepwater artificial reefs or oil spill cleanups, were coded as not applicable ("NA"). There were also only two projects that related to the agriculture topic, so I excluded those for simplicity.

A broad summary of the principles I used to characterize projects according to the other rules follows. ***Appendix 4-A*** provides the rules I used to characterize projects in more detail.

New Development (A.04-05, 09) & Existing Development

For development that isn't coastal-dependent and isn't critical infrastructure, retreat should be prioritized, and new protection should only be allowed for unmodified existing buildings at risk.

Soft Solutions (A.19) & Shoreline Protection (A.20)

In all cases soft shoreline stabilization solutions are preferable to hard ones. The Coastal Commission Guidance describes soft solutions to include "vegetative planting, dune restoration, and sand nourishment." The Soft Solutions Goal also identifies a few strategies that apply in non-hazardous areas within the coastal zone and areas outside of the coastal zone. These strategies encourage removing dams and prohibiting sand mining through regional sediment management partnerships.

Critical Infrastructure (A.26-28), Transportation (A.31-33), & Outfalls/Intakes (E.03)

Critical infrastructure that is not coastal-dependent should plan for retreat but may use accommodation strategies (e.g., retrofitting to withstand rising sea level) until services have been replaced inland. These facilities may be protected only where inland alternatives do not exist. In contrast, coastal-dependent critical infrastructure should retreat if alternative inland locations exist but should prioritize accommodation strategies, and only protect where necessary.

Beaches & Coastal Recreation (B.02-05)

Coastal recreation infrastructure should retreat when needed, may use accommodation strategies when necessary, and protect only when the infrastructure is deemed coastal-dependent, such as is the case for the California Coastal Trail. Beach managers should plan for removal of hard shoreline stabilization over time.

Habitat (C.01)

Coastal communities should preserve open space adjacent to the coast to allow for the natural retreat of coastal habitats.

Sediment Management (C.06)

This strategy applies in non-hazardous areas of the coastal zone and areas outside of the coastal zone. It encourages restoring natural channels in streams that have been armored or channelized to increase the supply of sediment to beaches and other coastal habitats.

Water Capture/Recycling (E.01-02)

This strategy applies in non-hazardous areas of the coastal zone and areas outside of the coastal zone. It encourages stormwater capture and water recycling, increasing the capacity of stormwater infrastructure, and using green stormwater infrastructure as ways to accommodate sea level rise and reduce upstream flooding in areas not at risk of erosion (E.01-02).

Scoring projects according to the Coastal Commission Guidance

The third level scores these "recommended actions" into the following categories: opposed, neutral, supportive, not addressed, and not regulated. The scoring system I used is described in Table 4-2. Projects that were described as "prohibit," "avoid," and "limit" in the Coastal Commission Guidance, or were contrary to what is described in the Coastal Commission Guidance were given a score of "opposed." Projects which the Coastal Commission Guidance expressed conditional approval of, were not restricted, or were described as allowed by state law were given a score of "neutral." Projects described as something to encourage or complementary

to encouraged activities in the Coastal Commission Guidance were given a score of "supportive" (Table 4-2).

Analysis

This research aims to characterize the amount of overlap between the Corps' permitting and the Coastal Commission Guidance (CCC, 2018a) and how aligned the Corps' permitting is with the Coastal Commission Guidance, particularly for areas of substantial overlap. I defined substantial "overlap" to be more than 100 authorized projects associated with a particular goal. To identify other sea level rise goals of interest, I used a threshold where more than 50% of projects were "supportive" or "opposed."

The Corps does not control the types of projects it receives permit requests for. However, the Corps does have the authority to write streamline permits for categories of activities with no more than minimal adverse effects to aquatic resources (33 U.S.C. 1344(e)). By doing so, the Corps indirectly creates an incentive for applicants to qualify for the streamlined permit (IWR, 2015). By assessing "alignment" with the Coastal Commission Guidance, I am evaluating the degree to which the Corps' use of streamlined permits have been incentivizing activities "supportive" under the Coastal Commission Guidance (or its use of non-streamlined permits have been passively dis-incentivizing "opposed" activities).

Under this definition of "alignment," projects that are "supportive" to the Coastal Commission Guidance are in alignment if they were authorized with a streamlined permit more frequently than expected. The converse is also true; "opposed" projects authorized with a non-streamlined permit more frequently than expected are also in alignment.

Of the 1,592 Corps-authorized projects in this study that are related to the guidelines, 95% of them used a streamlined permit and 5% used a non-streamlined permit. The underlying reason for this is unimportant here but the extremely skewed distribution in favor of streamlined permits establishes the expectation that any grouping of the data would contain 95% streamlined permits and 5% non-streamlined permits. Therefore, to assess "alignment" between the Corps' permitting and the Coastal Commission Guidance, I calculated the percent of "opposed" and "supportive" projects authorized by the Corps with streamlined and non-streamlined permits by the Coastal Commission Guidance's goals. Then I used the threshold of 95% to identify goals for which the actual percent of streamlined permits was less than expected for "opposed" projects and more than expected for "supportive" projects.

Results

Authorized Projects Relative to the Coastal Commission Guidance

The Los Angeles and San Francisco Districts authorized a total of 6,910 projects in California between 2012 and 2022. The majority (55%, N=3,792) of these occurred in watersheds that drained away from the coastal zone or into the San Francisco Bay and were, thus, outside the geographic scope of this study. Of the remaining 3,118 projects, 1,526 (49%) were not regulated by the Coastal Commission nor applicable to the Coastal Commission Guidance (CCC, 2018b) as I described in the methods section. Another 660 (21%) were for projects upstream, in watersheds that drain to the Coastal Commission's coastal zone and therefore not regulated by the Coastal Commission, but are related to the Coastal Commission Guidance. The remaining 932 (30%) were for activities within the coastal zone and, therefore, regulated by the Coastal Commission.

Overall, “supportive” projects were the most numerous, accounting for 43% of all projects related to the Coastal Commission Guidance and authorized by the Corps between 2012 and 2022, while “opposed” projects only accounted for 22% of projects (Figure 4-1). Within the supportive projects, 69% (N=474) were “encourage” actions and 31% (N=216) were “complementary” actions. Within the opposed projects, 99% (N=351) were “contrary” actions and 1% (N=2) were “avoid” actions.

“Supportive” projects were also the most numerous for all years except 2014. In addition, the relative number of “supportive” projects increased 14.8 percentage points (N increased 66.7%) from 2014 to 2022 (Figure 4-2). In contrast, “opposed” projects decreased 8.4 percentage points from 2014 to 2022 (N decreased 20.5%). Recall, 2014 is the year when the Coastal Commission began applying the policies described in the Coastal Commission Guidance, which were published in 2015. The percentage of “neutral” projects fluctuated with no clear trend. The percent of “not addressed” projects also declined over the study period, despite some year-to-year variability.

Projects scored as “neutral” (light orange, yellow, and light green in Figure 4-3) represented 43% (N=398) of all projects in the Coastal Zone, while “supportive” projects (green and dark green) represented 28% (N=260), “not addressed” projects (dark grey, mostly maintenance and replacement of private boat docks) represented 16% (N=149), and “opposed” projects (orange, red orange, red, and dark red) represented 13% (N=125) (Figure 4-3). Recall, the “neutral” category includes new hard stabilization to protect an existing structure in danger from erosion (mandated by the Coastal Act), new and ongoing development at ports and other coastal-dependent critical infrastructure, and maintenance of non-coastal development in hazard areas without renovating, upgrading, or expanding the existing structure. Of the projects scored as “supportive,” 86% (N=223) were of the type “encourage” (dark green) and 14% (N=37)

were of the type “complementary” (green). For the projects scored as “opposed,” 97% (N=121) were of the type “contrary” (orange), 2% (N=2) were of the type “avoid” (red), 1% (N=1) were of the type “prohibit” (dark red), and 1% (N=1) were of the type “limit” (red orange).

Upstream of the coastal zone, “supportive” projects accounted for 65% (N=430) of the Corps-authorized projects that were related to the Guidelines. “Opposed” projects accounted for 35% (N=230). All the “opposed” projects (N=230) were of the “contrary” type. For the “supportive” projects, 58% (N=251) were of the “encourage” type and 42% (N=179) were of the “complementary” type.

The goals in the Coastal Commission Guidance that were associated with more than 100 Corps-authorized projects were Sediment Management (N=500), Transportation (N=247), Water Capture/Recycling (N=237), Existing Development (N=143), Soft Solutions (N=108), and Beaches & Coastal Recreation (N=104) (Figure 4-4). Goals with more than 50% of the projects scored as “opposed” were Sediment Management (55%, N=275) and Shoreline Protection (55%, N=32). Conversely, the goals with more than 50% of the projects scored as “supportive” were Habitat (99%, N=74), Water Capture/Recycling (92%, N=218), New Development (66%, N=25), and Soft Solutions (59%, N=64).

Under the Sediment Management Goal, 55% (N=275) were of the recommended action type “opposed”, 42% (N=212) were “supportive” and 3% (N=13) were “neutral”. In the coastal zone, a similar percentage were “opposed” (56%, N=56). However, fewer projects were “supportive” (31%, N=31) and the same number representing a larger percentage were “neutral” (13%, N=13). “Opposed” projects also represented a similar percentage (55%, N=219) of projects upstream of the coastal zone but more projects were “supportive” (45%, N=181) and no projects were “neutral.”

Most of the projects under the Transportation (74%, N=184) and Beaches & Coastal Recreation (63%, N=66) Goals were neutral to the Coastal Commission Guidance. In addition, the vast majority (97%, N=138) of the projects associated with the Existing Development Goal were related to maintaining or expanding private boat access (e.g., docks and piers), which are not addressed by the Coastal Commission Guidance. These goals were not related to permit actions outside of the coastal zone.

Under the Water Capture/Recycling Goal, most of the projects were "supportive" (92%, N=218). In addition, 5% (N=12) were "neutral", 2% (N=5) were "not addressed", and 1% (N=2) were "opposed". Of the projects associated with this goal in the coastal zone, a smaller percentage (73%, N=47) were "supportive," a larger percentage were "neutral" (19%, N=12), and there were no "opposed" projects. An additional 8% (N=5) were "not addressed." These "not addressed" projects consisted of new stormwater management facilities for infrastructure that is not in a hazard area. For the projects associated with this goal upstream from the coastal zone, a slightly higher percentage were "supportive" (99%, N=171) and the same number were "opposed" (1%, N=2).

Under the Soft Solutions Goal, the majority of projects were "supportive" (59%, N=64). Another 30% (N=32) were "neutral" and 11% (N=12) were "opposed". In the coastal zone, the majority of projects were "neutral" ("neutral" (56%, N=32)), followed by "supportive" projects (39%, N=22) and "opposed" projects (5%, N=3). Upstream from the coastal zone, however, the majority of projects were "supportive" (82%, N=42), followed by "opposed" projects (18%, N=9).

The majority of projects under Shoreline Protection were "opposed" (55%, N=32). Another 43% (N=25) were "neutral" and only 2% (N=1) were "supportive". All the "neutral"

projects were "conditional" (N=25), which consist of projects to add, upgrade, or maintain hard shoreline stabilization for the projection of any type of existing structure in a hazard area.

Permitting Alignment

Figure 4-5 provides a visualization of the alignment between the Corps' permitting and the Coastal Commission Guidance by goal. When the percent of "opposed" projects authorized with a streamlined permit (bars in purple hues) was *less than* 95%, the Corps permitting was aligned for that goal. When the percent of "supportive" projects authorized with a streamlined permit is *more than* 95%, the Corps permitting was aligned for that goal.

Several of the goals have fewer than 10 associated "opposed" or "supportive" projects (Figure 4-5). For these goals, drawing conclusions about permitting alignment would be risky due to the small number of associated projects. More of the goals with more than 10 associated "opposed" projects were aligned than misaligned (3 versus 2). These misaligned goals were Shoreline Protection (A.20) and Sediment Management (C.06). The same number of goals with more than 10 associated "supportive" projects were aligned as misaligned (4 and 4). The misaligned goals were: New Development (A.04-05, 09), Soft Solutions (A.19), Transportation (A.31-33), and Habitat (C.01). Below, I look more closely at the four goals with the most misalignment: Sediment Management, Shoreline Protection, Transportation, and Soft Solutions.

Sediment Management (C.06)

The Sediment Management Goal focuses on using regional sediment management to identify opportunities for restoring natural sediment sources to wetlands, beneficial reuse of

sediment to support wetland restoration, and restoring natural channels in streams and waterways that have been armored or channelized. Under this goal, the Corps authorized 98% (N=269) of "opposed" projects with streamlined permits (2%, N=6 non-streamlined permits) and 99% (N=210) of "supportive" projects with streamlined permits (1%, N=2 non-streamlined permits). As described above, this goal is aligned for supportive projects but misaligned for opposed projects (e.g., hardening stream channels).

The majority of "opposed" projects under this goal were to construct new hard bank stabilization (81%, N=223), regardless of whether the project was in or out of the coastal zone. Of the "opposed" projects, there were 80% (N=219) were in upstream watersheds and 20% (N=56) were in the coastal zone. Supportive projects were more varied. Forty-five percent (N=95) were for new natural grade/headcut stabilization, 24% (N=51) were for bioengineered bank stabilization, 19% (N=41) were for restoring streams to a natural condition that had been hardened, 6% (N=13) were for installing soft bank stabilization, and 6% (N=12) were for other supportive activities, including 2% (N=4) for wetland sediment augmentation. Eighty-five percent (N=181) were in upstream watersheds and 15% (N=31) were in the coastal zone.

The permit types used to authorize opposed projects were nationwide permit (60%, N=166), regional general permit (33%, N=92), letter of permission (4%, N=11), and standard permit (2%, N=6). Of the opposed projects authorized with a streamlined permit, 30.5% (N=82) were authorized by the Districts' Emergency RGPs: Repair and Protection Activities in Emergency Situations, 25.3% (N=68) were authorized by NWP-13: Bank Stabilization, 10.8% (N=29) were authorized by NWP-14: Linear Transportation Projects, and 10% (N=27) were authorized by NWP-03: Maintenance. The remaining 23% (N=63) were authorized by a variety of other nationwide permits.

One thing to note is that 73% (N=38) of bioengineered bank stabilization projects were authorized by San Francisco District and 27% (N=14) were authorized by Los Angeles District. This is probably due to differences in rainfall patterns, the typical stream gradients, and flow regimes between Northern and Southern California, particularly through areas with transportation and other infrastructure, that make Northern California rivers more compatible with bioengineering techniques (H. H. Allen & Leech, 1997). Other factors, such as differing levels of stream alteration and urbanization, are probably also important.

Shoreline Protection (A.20)

The Shoreline Protection Goal says to only use hard shoreline protection under the limited circumstances described by the Coastal Act and if no feasible less damaging alternative exists. All 58 of these projects were located in the coastal zone. Under this goal, the Corps authorized 100% (N=32) of "opposed" projects with streamlined permits and 100% (N=1) of "supportive" projects with non-streamlined permits. The Corps' permitting under this goal, as described above, was misaligned for both "supportive" and "opposed" projects. However, there was only one supportive project under this goal, which is too few to draw conclusions from. This project was for reducing existing hard shoreline stabilization protecting a non-coastal habitat in the coastal zone. There were 32 (55%) "opposed" projects, which primarily consisted of adding riprap seaward of existing hard shoreline stabilization (81%, N=26).

The Corps used the following permit types to authorize opposed projects: nationwide permit (18.8%, N=6) and regional general permit (81.2%, N=26). Of the projects authorized with a Nationwide Permit, 83% (N=5) used NWP-03: Maintenance and 17% (N=1) used NWP-13: Bank Stabilization. All 26 of the projects authorized with a Regional General Permit used RGP-SPL-084: Huntington Harbor Bulkhead Repair and Rehabilitation. RGP-SPL-084 was for

the repair and rehabilitation of bulkheads in Huntington Harbor. This permit was last used in 2014. It expired on 25 November 2018 and has not been renewed (Los Angeles District (2023)).

Transportation (A.31-33)

The focus of the Transportation goal is to protect transportation infrastructure, including ports, while encouraging relocation of any transportation infrastructure that is not coastal-dependent. Under this goal, the Corps authorized 36% (N=5) of "opposed" projects with streamlined permits (64%, N=9 non-streamlined permits) and 84% (N=41) of "supportive" projects with streamlined permits (16%, N=8 non-streamlined permits). As described above, this goal is aligned for "opposed" projects and misaligned for "supportive" projects. However, a larger percentage of "supportive" projects use a streamlined permit than "opposed" projects. This indicates the Corps' permitting of "supportive" projects is approaching alignment under this goal.

All 247 of the projects associated with this goal were located in the coastal zone. "Opposed" projects (e.g., expanding existing routes in hazard zones) accounted for 6% (N=14) of all projects under this goal and "supportive" projects (e.g., relocating transportation facilities inland or expand existing routes in non-hazardous areas of the coastal zone) accounted for 20% (N=49).

For the misaligned supportive projects, 75.5% (N=37) were authorized with a nationwide permit, 6.1% (N=3) were authorized with a regional general permit, 2% (N=1) were authorized with a letter of permission, and 16.3% (N=8) were authorized with a standard permit. Of the supportive projects authorized with a Standard Permit, four were larger than the typical 0.5-acre threshold found in the nationwide permits. The remaining four had less than 0.5-acre

permanent impacts to the Corps' jurisdiction. Three of these were to expand or upgrade a transportation route in a non-hazardous area of the coastal zone and one was to retrofit transportation infrastructure. It's not clear why these projects required a Standard Permit given their relatively small impact size. Two were authorized before 2017, when removing structures and fill was added to the category of activities covered by Nationwide Permit 3. It is possible that Nationwide Permit 3 would be used for these two projects if they were authorized today.

Soft Solutions (A.19)

This goal promotes the use of "green" shoreline protection infrastructure as a preferred alternative, such as living shorelines, restoring natural sand supply to beaches, and beneficial reuse of sediment. Under this goal, the Corps authorized 67% (N=8) of "opposed" projects with streamlined permits (33%, N=4 non-streamlined permits) and 89% (N=57) of "supportive" projects with streamlined permits (11%, N=7 non-streamlined permits). Similar to the Transportation Goal, this goal is aligned for "opposed" projects and misaligned for "supportive" projects, but a larger percentage of "supportive" projects use a streamlined permit than "opposed" projects.

There were 108 projects associated with this goal. Of these 59% (N=64) were "supportive" and 11% (N=12) were "opposed". Of the "opposed" projects (e.g., constructing a new dam or mining for sand), 75% (N=9) were in upstream watersheds and 25% (N=3) were in the coastal zone. Of the "supportive" projects (e.g., living shorelines, beach nourishment, and removing dams), 66% (N=42) were in upstream watersheds and 34% (N=22) were in the coastal zone.

For the "supportive" projects associated with this goal, 75% (N=48) were authorized with a nationwide permit, 14.1% (N=9) were authorized with a regional general permit, and 10.9% (N=7) were authorized with a standard permit. Of the projects authorized by Standard Permit, three were for dredging with beach nourishment, two were for living shorelines, and one each were for dam removal and sand bypassing. While both living shorelines permits have end dates of 2017 or later (the year when the Nationwide Permit for living shorelines (NWP-54) was first issued), the impact area for these projects (1.34 and 1.44 acres) was larger than the typical 0.5-acre threshold for impact size found in the nationwide permits (USACE, 2017).

Discussion

The goals of this research were to understand the areas of overlap between the Corps' permitting in the coastal zone and the adaptation strategies identified in the Coastal Commission Guidance and identify areas for which the Corps' permitting is misaligned with this guidance. The Corps' main areas of overlap with the Coastal Commission Guidance were with the Sediment Management Goal (C.06) due to the large number of bank stabilization projects the Corps authorized in the coastal zone and upstream, and the Transportation Goal (A.31-33) due to the large number of port and transit maintenance activities the Corps authorized in the coastal zone. The Corps' permitting was misaligned when authorizing "opposed" projects associated with the Shoreline Protection and Sediment Management Goals (e.g., streamlined permitting was used for more than 95% of projects to perpetuate hard shoreline stabilization or armor stream channels). The Corps' permitting was also misaligned when authorizing supporting projects under the New Development, Soft Solutions, Transportation, and Habitat Goals (e.g., streamlined permitting was used for less than 95% of projects to construct new development outside hazard areas, create living shorelines, expand transportation routes outsize hazard areas, or restore coastal habitat).

Any effort the Corps makes to align with the Coastal Commission Guidance and make it easier to obtain a permit for sea level rise adaptation and retreat strategies (or make it harder to obtain a permit for defend strategies) would have to be made by the Corps' California Districts. The California Districts ability to make it easier to obtain a permit for sea level rise adaptation and retreat strategies is limited to issuing new General Permits to cover adaptation and retreat strategies that are not already covered and working harder to seek categorical approvals from the Coastal Commission and other agencies for new and existing General Permits. The only way the Corps can make it harder to obtain a permit for defend strategies is to suspend specific nationwide permits, add regional conditions to the nationwide permits restricting their use, and not renew certain Regional General Permits.

The Corps has already taken some steps that have helped align its permitting with the Coastal Commission Guidance. In 2017, the Corps added the removal of previously authorized structures or fill in the category of activities authorized by Nationwide Permit 3 for maintenance activities. It also issued Nationwide Permit 54 for living shorelines. Between 2017 and 2022 in the Coastal Commission's coastal zone, the Corps authorized six living shoreline projects, but Nationwide Permit 54 was only used twice. Living shorelines are generally acceptable for use in environments with low to moderate wave energy (Bridges et al., 2013; Walker et al., 2011), which may explain why only eight living shoreline permits have been authorized along California's open coast between 2012 and 2022. This does not explain why only 33% of the living shoreline projects after 2017 were authorized with the Living Shoreline Nationwide Permit. Nor does this explain why 33% were authorized with other General Permits and 33% were authorized with a Standard Permit.

Interestingly, there are some instances of Nationwide Permit 3, Nationwide 12 (utility lines), and Nationwide 14 (linear transportation projects) being used to authorize new armoring

of the shoreline and stream banks. This can happen when it is in connection with maintenance or repair of existing infrastructure but may have additional implications. Due to the lack of a specific size threshold in Nationwide Permit 3 the 0.5-acre threshold in Nationwide Permits 12 and 14, compared with the 500 linear foot threshold in Nationwide Permit 13, a regional condition of this kind could also prevent larger stabilization projects being authorized under other permits than would be allowed under Nationwide Permit 13.

Both steps above are examples of improving alignment for "supportive" projects by writing new General Permits, which may be easier than improving alignment for "opposed" projects by conditioning or revoking already issued General Permits. For example, the Corps can only issue General Permits to authorize "a category or categories of activities when: (1) Those activities are substantially similar in nature and cause only minimal individual and cumulative environmental impacts; or (2) The General Permit would result in avoiding unnecessary duplication of the regulatory control exercised by another Federal, state, or local agency provided it has been determined that the environmental consequences of the action are individually and cumulatively minimal." (33 CFR 322.2(f)). However, the Corps can only suspend or modify a previously authorized Regional General Permit "if it is determined that it is contrary to the public interest" (33 CFR 325.2(e)(2)). For a Nationwide Permit, the Corps District can only suspend, modify, or suspend authorizations under a Nationwide Permit "for cases where they have concerns for the aquatic environment under the Clean Water Act section 404(b)(1) Guidelines or for any factor of the public interest" (33 CFR 330.1(d)). In the above, "the public interest" refers to the Corps' qualitative "evaluation of the probable impact which the proposed activity may have on the public interest" by "careful weighing of all those factors which become relevant in each particular case" (33 CFR 320.4(a)). The specific factors are also listed at 33 CFR 320.4(a). Aligning with the Coastal Commission Guidance would only be one factor

considered in the Public Interest Review and would receive less weight than the direct and indirect effects to aquatic resources.

Seeking categorical approvals from the Coastal Commission (or any other agencies) for new and existing General Permits is also challenging. The agency's decision would have to be consistent with their own, independent, regulatory authorities. For example, the Coastal Commission doesn't issue categorical Coastal Development Permits. Instead, they either write a Categorical Exclusion Order that excludes an activity from the need for a Coastal Development Permit (California Coastal Act, Pub. Res. Code § 30610(e)) or they work with local jurisdictions to develop Local Coastal Programs. Once a Local Coastal Program is certified, the local jurisdiction can issue Coastal Development Permits according to the Local Coastal Plan (C. Lester, 2013).

A Categorical Exclusion Order can be issued if the project has "no potential to result in adverse impacts to coastal resources" (California Coastal Act, Pub. Res. Code § 30610(e)). This standard is more restrictive than the Corps' "no more than minimal adverse effects" standard for a General Permit. The Local Coastal Programs are more analogous to the Corps' General Permits. The Coastal Commission must evaluate the proposed Local Coastal Program for consistency with the Coastal Act, using the same standards of review as it would for an individual Coastal Development Permit.

Despite these analogous processes to streamline permitting in the coastal zone, the Coastal Commission has "a longstanding practice of objecting to [the Corps' nationwide permits] and carrying out individual reviews instead" (Cassidy Teufel, California Coastal Commission, pers. comm.). I suspect that the reason the Coastal Commission has taken this approach is because the Corps' California Districts have not made any attempts to further restrict the

nationwide permits in a way that harmonizes them with either a Categorical Exclusion Order or a Local Coastal Program. In contrast, New England District has suspended all nationwide permits and replaced them with a set of separate Regional General Permits unique to each state within the District's area of responsibility (New England District, 2022). In states that have overlapping permit authority, the Regional General Permits mirror the state's permit requirements. In these cases, activities authorized under the state's program that don't trigger other types of reviews required by federal law (such as a Section 7 Endangered Species Action consultation) may be "self-verified" by the project proponent. The project proponent only needs to receive confirmation from the Corps that the project is eligible for self-verification. If the activity triggers other types of review required by federal law, then the project proponent must submit a "pre-construction notification" to the Corps, so it can verify the activity under the General Permit after completing the other mandatory federal consultations.

Recommendations

Considering the above, the Corps' California Districts could take the following steps to improve the efficiency of permitting for sea level adaptation efforts.

Discouraging "Opposed" Projects

Restrict Use of Hard Stabilization in General Permits

Write a regional condition to the nationwide permits that would exclude hard stabilization from the authorized category of activities. This approach would force hard stabilization projects into a Standard Permit where alternatives could be analyzed, including softer stabilization alternatives. The drawback of this approach is that bioengineering

techniques (i.e., alternatives to hard stabilization) are not currently applicable to all types of streams found in California. To address this knowledge gap, the Corps should encourage research and development into bioengineered bank stabilization techniques that can be used in streams with steeper gradients and flashier hydrology, such as are more common in Southern California. Having regionally appropriate strategies that are appropriate for a wider range of hydrologic and hydraulic scenarios will allow for less-impactful choices, including potential application in emergencies.

Close Emergency Regional General Permit Loophole for Hard Stabilization

Clarify that the Districts' emergency Regional General Permits are not to be used for permanent hard stabilization projects in future iterations of the permit. Instead, temporary stabilization can be authorized with the emergency permit and any permanent hard stabilization require a separate application that goes through the normal (non-emergency) review process. This approach is also in keeping with how the Coastal Commission handles emergency coastal development permit applications.

Close Loopholes in the Nationwide Permits for Hard Stabilization

Consider suspending a regional condition to the nationwide permits that prohibits any permit other than Nationwide Permit 13 and Nationwide Permit 54 from being used for new shoreline or bank stabilization. This is consistent with the preamble language in the 2021 issuance of Nationwide Permit 13 but could be formalized by the coastal California Districts with a regional condition.

This would be beneficial because it would close two loopholes apparently used to authorize hard stabilization projects. First, the size limits differ across Nationwide Permits. For example, Nationwide Permit 13 limits bank stabilization to "no more than 500 feet in length" and may not exceed "an average of one cubic yard per running foot" (USACE, 2021). Assuming a maximum allowable project footprint of 500 feet by 3 feet (one yard), the impact area would be 0.03 acre. In contrast, Nationwide Permit 14: Linear Transportation Projects limits permanent impacts to 0.5 acre in freshwater (0.3 acre in tidal waters) (USACE, 2021). Similarly, Nationwide Permit 3: Maintenance is restricted to "minor deviations… necessary to make the repair…" (USACE, 2021).

Second, the Nationwide Permits prohibit "piecemealing" to avoid the size limits in the Nationwide Permit. Instead, it requires that all impacts related to the same project, including phased projects, be totaled when determining if the project falls within the size limits. This prevents a project proponent from breaking a long bank stabilization project into several pieces that each are smaller than 500 feet. However, if the project proponent were to use Nationwide 3: Maintenance to add new hard bank stabilization to protect a damaged road running parallel to a stream, there would be no size limits so long as the project proponent made the case that the stabilization is the "minimum necessary to make the repair."

Restrict Use of General Permits for Projects in Hazard Areas

Prohibit the use of NWP-39: Commercial and Institutional Developments and NWP-29: Residential Developments when the activity would be for new construction located within an area at risk as defined by the Coastal Commission Guidance. While this step may not affect many projects, it would help to align the Corps Regulatory Program with the Coastal Commission Guidance.

Restrict Use of General Permits for Hard Stabilization Seaward of Existing Stabilization

Consider adding a regional condition to the Nationwide Permits that prohibits the use of a General Permit for replacement of existing hard stabilization seaward of the existing stabilization. This would require the Districts to find that new stabilization placed seaward of the existing stabilization has more than minimal adverse effects on the aquatic environment, and might not be possible without peer-reviewed research to support this claim.

Encouraging "Supportive" Projects

Issue Regional General Permit for "Supportive" Projects Covered by a Certified Local Coastal Program

Write a Programmatic or Regional General Permit for activities that meet the Corps' standard of no more than minimal, that are aligned with "supportive" projects, and are covered under a certified Local Coastal Program. There are two advantages of this approach. First, the possibility of a Regional General Permit for activities under a Local Coastal Program may entice local jurisdictions to update their Local Coastal Programs to plan for sea level rise. Second, the Corps could seek blanket consistency certification from the Coastal Commission for the Regional General Permit and approval from other state and federal agencies, like the state's Regional Water Quality Control Boards and NOAA.

Issue a Regional General Permit that Covers de minimus "Supportive" Projects

Coordinate with the Coastal Commission to see what categories of sea level rise adaptation projects could qualify for their *de minimus* waiver and write a Regional General Permit to align with this waiver.

Waive Size Restrictions in Nationwide Permit 54 for Living Shorelines

Liberally using the Corps Districts' discretionary authority to waive the restrictions on the size of a living shoreline project that is granted in the terms of Nationwide Permit 54: Living Shorelines, given the environmental benefits of a living shoreline over hard shoreline stabilization and the identification of this strategy as preferred by the Coastal Commission.

Use Ecological Thresholds for Nationwide 54 (or Similar Regional General Permit)

Issue a statewide Regional General Permit for living shorelines that uses an ecological threshold for minimal impact (akin to Nationwide Permit 27 for restoration activities) rather than a size limit. The benefit of this approach is the potential for a Regional General Permit like this to receive a Categorical Exclusion Order from the Coastal Commission.

Conclusions

Sea level rise, like other effects of climate change, will likely cause billions of dollars of damage to California and elsewhere in the coming years. The threat of extreme wildfire–another effect of climate change–has already spurred the state and Corps to jointly write General Permits for wildfire prevention and other fire-related activities. Under the new, statewide Regional General Permit 10, activities such as relocating power lines underground in wind- and fire-prone areas, are now permitted through a more streamlined process. The permit was one in a small batch of new statewide General Permits jointly issued by the Corps' California Districts and were the first of their kind. These permits can serve as a roadmap for additional statewide General Permits to address sea level rise adaptation. Eight years after the Coastal Commission first published their Coastal Commission Guidance, retreat is still not a palatable idea for many.

Recent experience has shown that community-lead, voluntary decisions to adapt by retreating is far more successful than government-forced relocation (Koslov, 2016). It will be the challenge of a generation to adapt to sea level rise and retreat from California's current position on the coast. It will be far easier if there are incentives that make the hard choices easier.

Tables

Table 4-1: Number of projects in the study that fell into each risk category by how risk was determined.

Risk	Location Reason	Count
subtidal	project description	29
	all	10
hazard area	CoSMoS projections	55
	TNC projections	190
	CCC definition	301
	project description	5
long term risk	CoSMoS projections	10
	TNC projections	37
not at risk	all	2,481

Table 4-2: System for scoring projects according to the Coastal Commission Guidance. See Appendix 4-A for additional details.

Score	Rec. Action	Meaning
opposed	prohibit	Prohibit activity (from the Coastal Commission Guidance)
	avoid	Avoid the activity (from the Coastal Commission Guidance)
	limit	Restrict or limit activity (from the Coastal Commission Guidance)
	contrary	Not specifically mentioned, but the opposite of a strategy described in the Coastal Commission Guidance
neutral	conditional	Conditional approval under circumstances described in the Coastal Commission Guidance
	neutral	Neutral to a strategy described in the Coastal Commission Guidance (e.g., maintenance to an existing structure)
	allow	Allow activity (from the Coastal Commission Guidance, e.g., upgrading hard shoreline stabilization for a coastal-dependent critical infrastructure or new development outside a hazard zone, but within a long-term risk area)
supportive	complementary	Not specifically mentioned, but the opposite of a discouraged activity or the complement of an encouraged activity
	encourage	Encourage the activity to take place (from the Coastal Commission Guidance) or would be encouraged if in the coastal zone
not addressed	not addressed	Activity is regulated but is not discussed in the Coastal Commission Guidance
not regulated	not regulated	Activity is either in coastal zone but exempt from CDP or not in the coastal zone and not mentioned in the Coastal Commission Guidance
NA	NA	Not related to the Coastal Commission Guidance

Figures

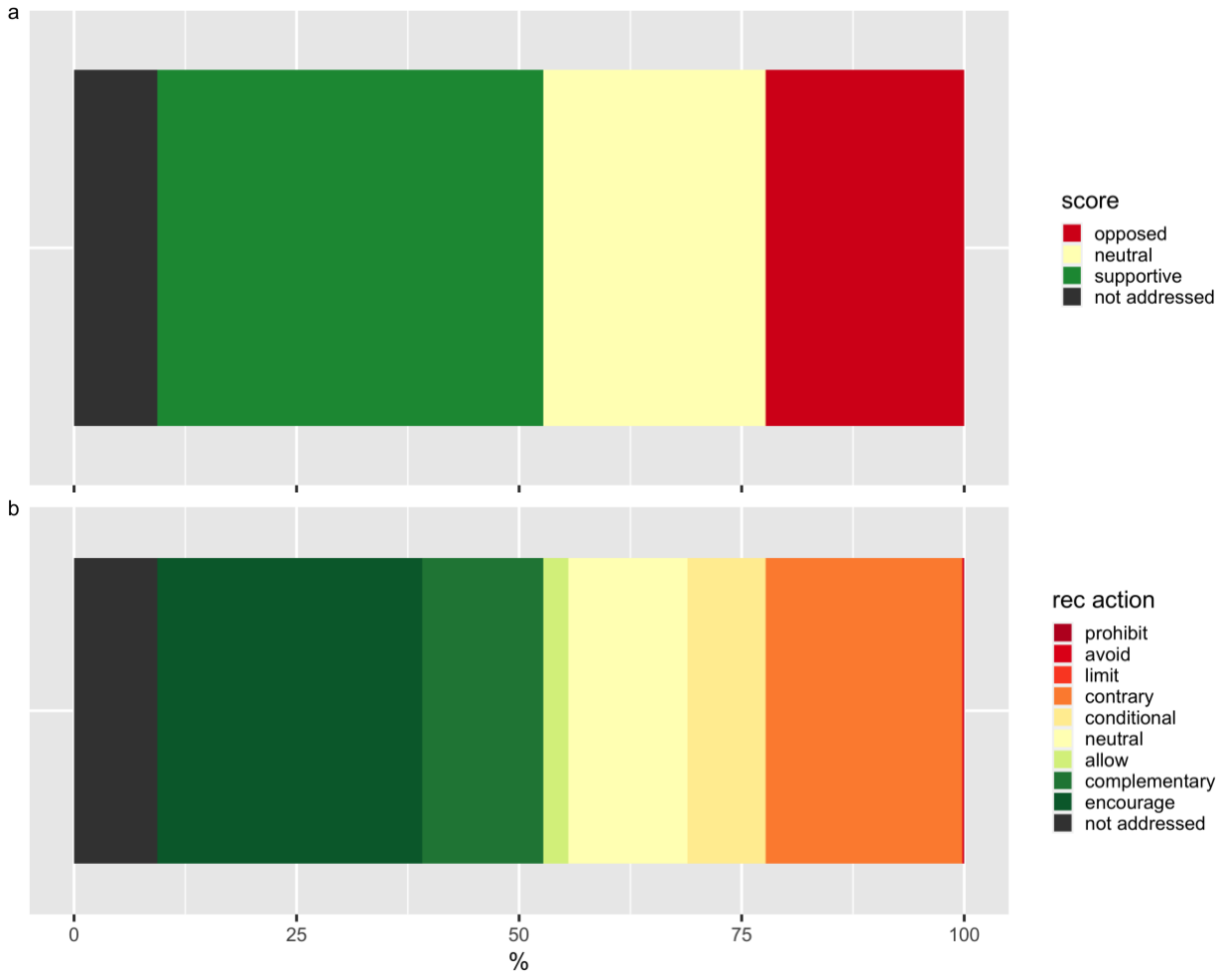

Figure 4-1: Percent of all projects related to the Coastal Commission Guidance and authorized by the Corps between 2012 and 2022. The figure also shows the nested categorization scheme used to relate the projects in the Corps' permit database with the Coastal Commission Guidance. Panel A shows the top-level "scoring." Panel B shows the second-level categorization (aka "recommended action"). Recall from the methods that recommended actions of "prohibit," "avoid," "limit," and "contrary" were scored as "opposed," whereas recommended actions of "complementary" and "encourage" were scored as "supportive," and so on.

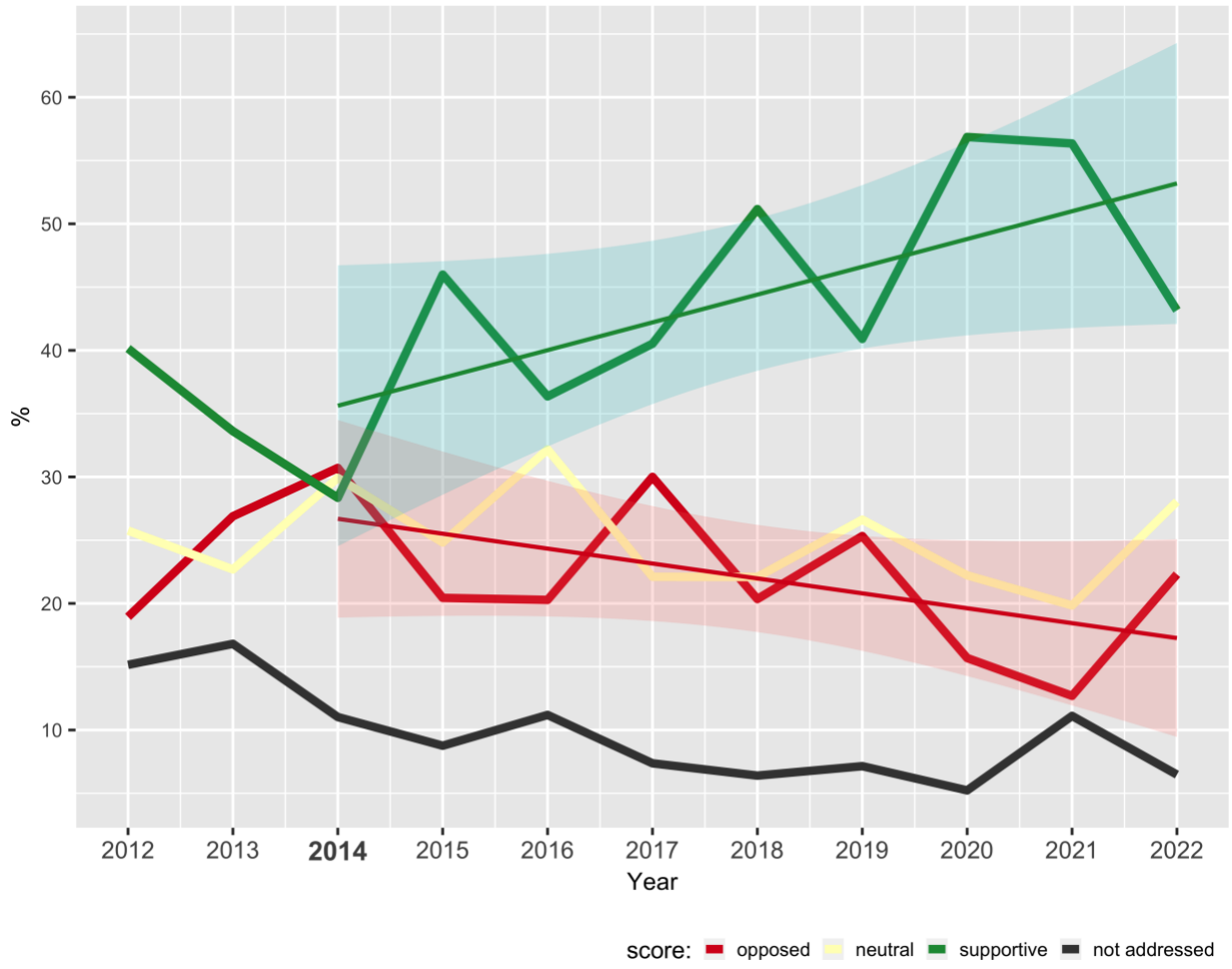

Figure 4-2: Annual percentage of opposed, neutral, and supportive projects authorized by the Corps in the coastal zone and upstream watersheds relative to the Coastal Commission Guidance. Trend lines and the 95% confidence intervals (shaded areas) are shown for supportive and opposed projects after 2014, when the Coastal Commission started to implement the policies in their Guidance.

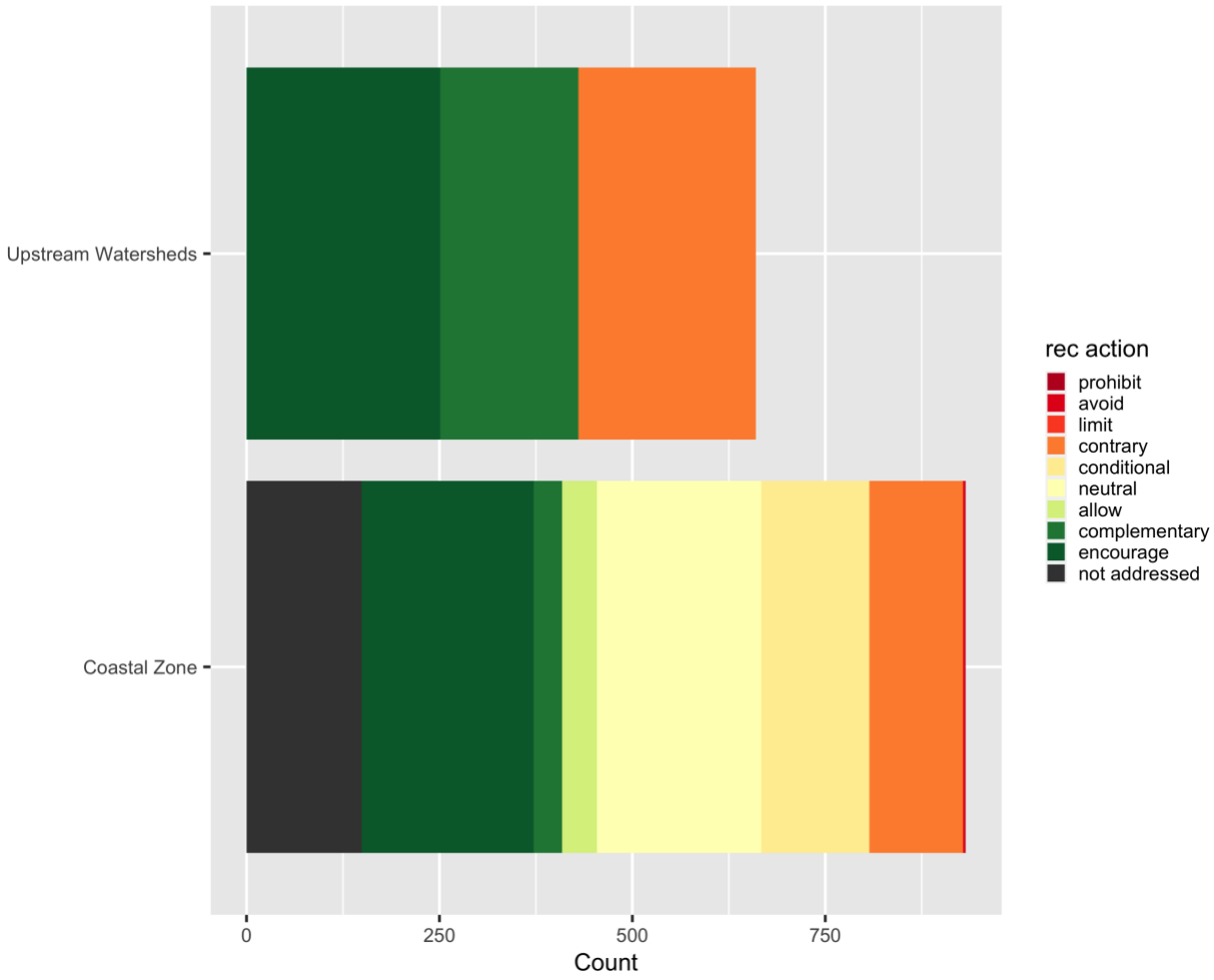

Figure 4-3: Number of projects related to the Coastal Commission Guidance and authorized by the Corps between 2012 and 2022, classified by the "recommended action" type (from the Guidance) and location relative to the coastal zone.

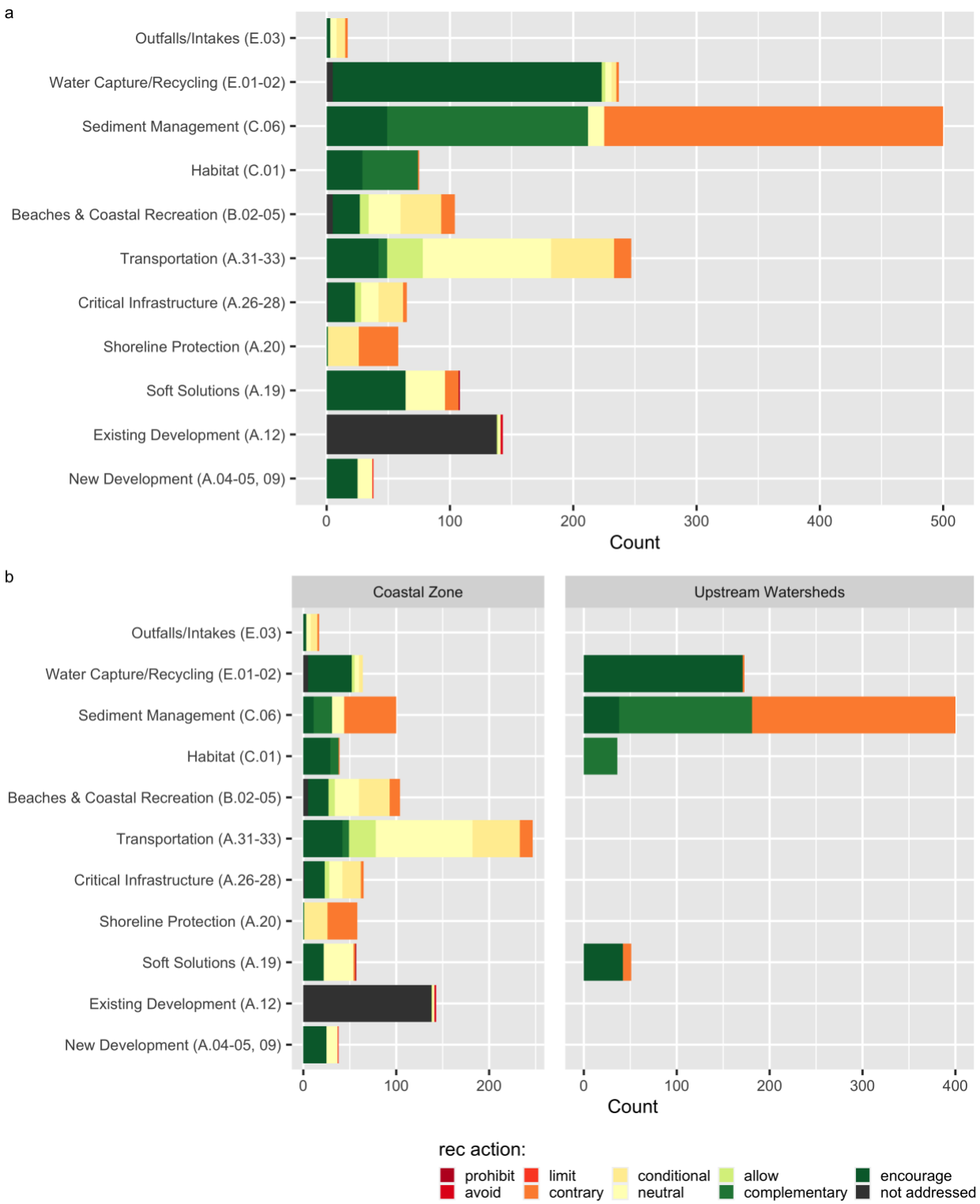

Figure 4-4: Number of Corps-authorized projects relative to the sea level rise goals and recommended actions in the Coastal Commission Guidance. Panel A shows this relationship overall. Panel B compares the relationship between the goals and Corps-authorized projects in the coastal zone to the upstream watersheds.

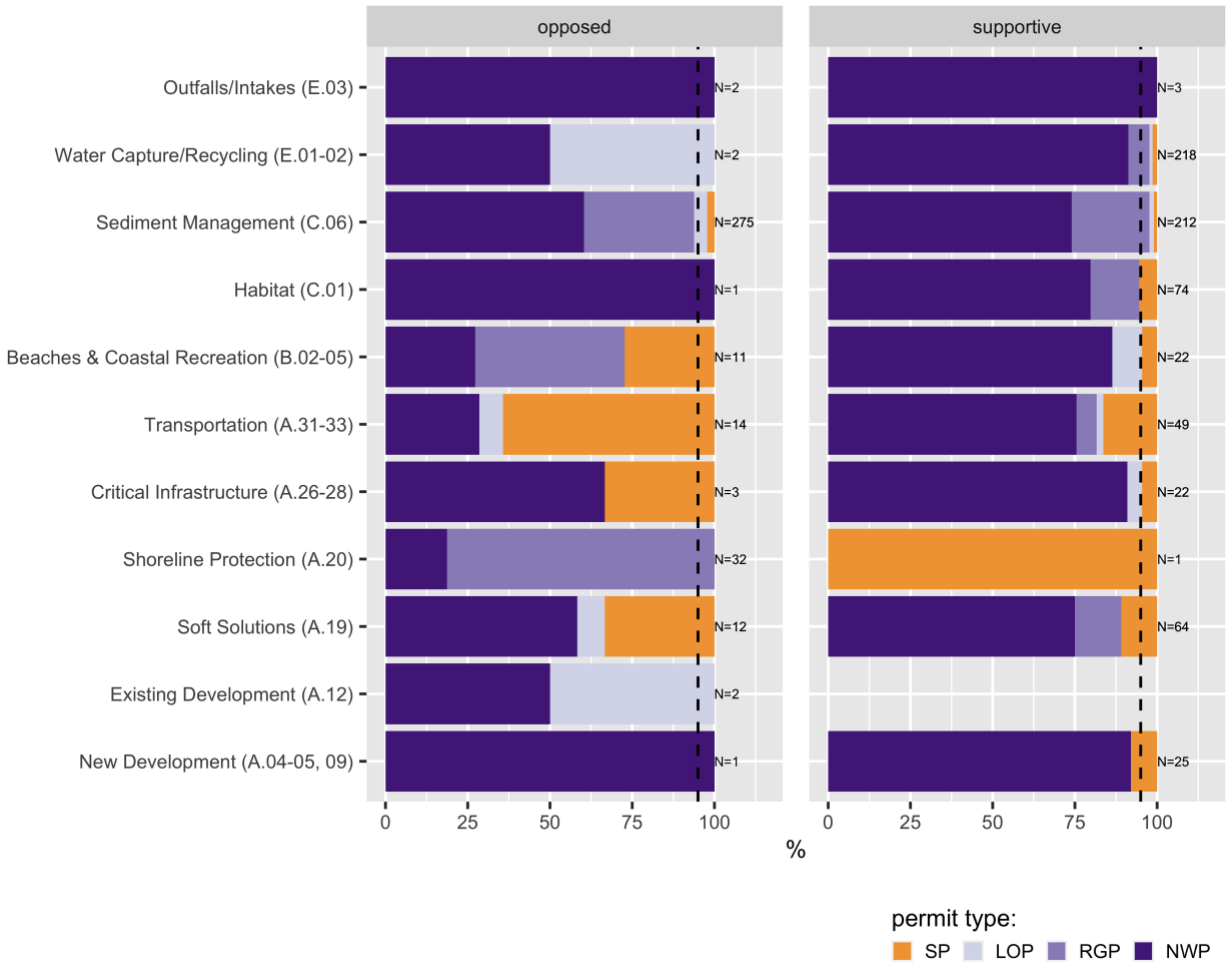

Figure 4-5: Percent of authorized projects that are opposed or supportive relative to the goals in the Coastal Commission Guidance and by Corps permit type. The dashed line represents the 95% streamlined-permit-threshold for determining alignment or misalignment. For "opposed" projects, a goal is aligned if streamlined permits account for less than 95% of projects authorized under that goal (i.e., the purple hued bars are to the left of the dashed line and the dashed line intersects an orange bar, representing non-streamlined permits). For "supportive" projects, a goal is aligned if the streamlined permits account for more than 95% of projects under that goal (i.e., the purple hued bars extend to the right of the dashed line, which intersects a purple hued bar).

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Appendix 4-A: Supplemental Methods

New Development

A.04: Limit new development in hazardous areas. New development projects were coded as "limit" in hazard areas and "allow" in long-term risk areas.

A.05: Cluster development away from hazard areas. New development, upgrades, and expansions in areas of the coastal zone that are not at risk were coded as "encourage." Maintenance of or improvements to development and their associated infrastructure in areas of the coastal zone that are not at risk were coded as "neutral." Development and associated stormwater infrastructure in long-term risk areas were coded as "allow." Since the Coastal Commission doesn't regulate development outside the coastal zone, all development projects outside the coastal zone were coded as "not regulated."

A.09: Analyze options for removal when planning and designing new development, including avoiding shoreline protection for new development. Projects to remove development from hazard areas in the coastal zone were coded as "encourage."

Existing Development

A.12: Avoid the expansion or perpetuation of existing structures in at-risk locations. Projects to replace or upgrade development in hazard areas of the coastal zone were coded as "avoid." Maintenance projects for existing development in hazard areas was coded as "neutral." Upgrades to development in long term risk areas were coded as "allow." The Coastal

Commission Guidance does not discuss how to treat projects that would perpetuate private boat docks associated with residential development in hazard areas. These projects were coded as "not addressed" everywhere.

Soft Solutions

A.19: Require the use of green shoreline protection infrastructure as a preferred alternative, restore natural sand supply to beaches, and beneficially reuse sediment. Living shorelines and other soft stabilization projects like beach nourishment were coded as "encourage" everywhere. Projects to bypass sediment around obstructions and remove obstructions were coded as "encourage" everywhere. Dredging projects in the coastal zone with beach nourishment were coded as "encourage." Dredging projects and sediment removal projects in the coastal zone without beach nourishment were coded as "neutral" because not all sediment is suitable. Projects to expand existing or create new dams were coded as "contrary" everywhere. Projects to mine sand or gravel were coded as "prohibit" if in the coastal zone and "contrary" elsewhere. Projects to maintain dams were coded as "neutral" in the coastal zone and "not regulated" elsewhere. Sediment removal outside the coastal zone was coded as "not regulated."

Shoreline Protection

A.20: Use hard shoreline protection only if allowable and if no feasible less damaging alternative exists. Projects to add, upgrade, or maintain hard shoreline stabilization for the projection of an existing structures in a hazard area were coded as "conditional," including non-coastal dependent critical infrastructure. However, if the new stabilization was constructed seaward of the existing stabilization, that was coded as "contrary"

because of the Coastal Commission's preference for new shoreline protection to be placed landward of existing shoreline protection (CCC, 2018b, Ch. 7, pg. 143). Projects to make hard shoreline stabilization smaller were coded as "complementary."

Critical Infrastructure

A.26, A.27, and A.28: Require special considerations for critical infrastructure and facilities. Projects to retrofit coastal-dependent critical infrastructure in the coastal zone were coded as "encourage." Projects to relocate or construct new coastal-dependent critical infrastructure were coded as "conditional" if they were sited in hazardous areas of the coastal zone. In contrast, projects to replace or construct new non-coastal-dependent critical infrastructure in hazardous areas were coded as "contrary." Projects to construct new or expand existing critical infrastructure in areas of the coastal zone not at risk were coded as "encourage." Maintenance or replacement of critical infrastructure in the coastal zone was coded as "neutral." Projects to construct new pumps for critical infrastructure in hazard areas was coded as "conditional" because the Coastal Commission Guidance says any infrastructure in hazard areas should be designed to withstand worst-case scenario sea level rise (CCC, 2018b, Ch. 7, pg. 141). Replacement or construction of new hard shoreline stabilization for existing coastal-dependent critical infrastructure was coded as "conditional," but maintenance of existing hard shoreline stabilization was coded as "allow." Projects to remove infrastructure from hazardous areas was coded as "encourage" everywhere, however the Coastal Commission Guidance does not address decommissioning in-place. Projects related to critical infrastructure outside the coastal zone were coded as "not regulated." Non-boat, non-transportation related military projects were coded the same as coastal-dependent critical infrastructure.

Transportation

A.31-32: Protect transportation infrastructure. Projects to relocate transportation facilities inland were coded as "encourage" everywhere. Projects to construct new, upgrade, or expand existing routes in non-hazardous areas of the coastal zone were coded as "encourage," "allow" in long-term risk areas, and as "contrary" in hazard zones. Projects to replace stretches of existing routes in hazardous areas were coded as "conditional" and neutral in non-hazardous areas. Projects to retrofit transportation routes for sea level rise were coded as "allow" in the coastal zone and "complementary" outside of the coastal zone. Maintenance of transportation infrastructure was coded as "neutral" throughout the coastal zone. The maintenance, replacement, or construction of new hard shoreline stabilization was coded as "allow." Projects related to transportation infrastructure outside the coastal zone were coded as "not regulated." Transportation-related military projects in the coastal zone were coded the same as transportation projects.

A.33: Incorporate sea level rise considerations into Port Master Plans and other port activities. Projects to retrofit port facilities for sea level rise or remove facilities from hazard areas, were coded as "encourage." Projects to relocate hard shoreline protection inland of the existing was coded as "encourage." Projects to retrofit, replace, or maintain existing hard shoreline protection was coded as "allow" because all these alternatives use the existing footprint. New hard shoreline protection was coded as "conditional," while relocation of hard shoreline protection seaward of the existing was coded as "contrary." The maintenance of existing port infrastructure is coded as "neutral," while all other modifications were coded as "conditional" because the Coastal Commission Guidance says it should all be done to withstand sea level rise. Boat-related military projects in the coastal zone were coded the same as port projects.

Beaches & Coastal Recreation

B.02-05: Maximize public access and recreational use by protecting beaches and other coastal areas and protect lower cost visitor and recreational facilities and accessways. Maintenance activities were coded as "neutral." Relocation of recreational facilities inland was coded as "encourage," but relocating them seaward was coded as "contrary." Retrofitting recreational facilities was coded as "encourage." Seasonal amenities were coded as "allow." Replacing, upgrading, expanding, or constructing new coastal facilities or amenities were coded as "encourage" in non-hazard areas, as "allow" in long term risk areas, and as "conditional" in hazard areas. Replacing or maintaining coastal access in hazard areas was coded as "neutral." Reducing hard shoreline stabilization was coded as "encourage." Maintaining, upgrading, or installing new soft stabilization was coded as "encourage." Removal of hard shoreline stabilization was coded as "encourage." Retrofitting hard shoreline stabilization was coded as "conditional." Maintenance of hard shoreline stabilization was coded as "neutral." Replacement or construction of new hard shoreline stabilization was coded as "contrary." Non-coastal recreation in the coastal zone is not addressed by the Coastal Commission Guidance and is not regulated outside of the coastal zone.

Habitat

C.01: Open space preservation and conservation. Projects to restore coastal habitats were coded as "encourage," except when hard shoreline stabilization is retained, then it is "contrary." Projects to restore non-coastal habitat in hazard areas were coded as "encourage" because these areas are presumed to be areas where coastal habitat will migrate to in the future. Similar projects that are not at risk or not in the coastal zone were coded as "complementary."

Sediment Management

C.06: Identify opportunities for regional sediment management to restore natural sediment sources to wetlands and beneficial reuse of sediment to support wetland restoration, including the restoration of natural channels in streams and waterways that have been armored or channelized. Projects to augment wetlands with sediment were coded as "encourage." Projects to restore natural stream channels by removing any kind of bank stabilization or grade control/headcut stabilization were coded as "encourage" everywhere. Projects to "soften" existing bank stabilization (e.g., remove concrete and replace with un-grouted rock), or construct new or replace existing soft or bioengineered bank stabilization (e.g., un-grouted rock filled with soil and planted with native riparian vegetation) were coded as "complementary" because these versions of bank stabilization support the principles in the Coastal Commission Guidance better than the alternative of new hard stabilization. Projects to maintain or replace existing hard stabilization were coded as "neutral" in the coastal zone and "not regulated" elsewhere. Projects to upgrade, expand, fortify existing hard bank stabilization, or construct new hard stabilization were coded as "contrary." Projects for which the bank stabilization technique was not clear were assumed to be hard stabilization and scored as described above. The same rules were also applied to grade control or headcut stabilization projects, in which natural grade control and headcut stabilization projects were coded the same as "bioengineered" bank stabilization.

Water Capture/Recycling

E.01: Update water quality Best Management Practices to provide greater infiltration of rainwater. Stormwater capture and wastewater recycling projects were coded as "encourage" everywhere except in hazard areas and "conditional" in hazard areas because the

Coastal Commission Guidance states sea level rise and extreme storms should be incorporated into the design.

E.02: Include sea level rise in stormwater management plans and actions, including to increase capacity of stormwater infrastructure in hazard areas and prioritizing green stormwater infrastructure. Projects to increase capacity of stormwater channels, culverts, or bridges (e.g., increasing the span) were coded "encourage" everywhere. Projects that reduced capacity (e.g., downsizing a culvert) were coded "contrary" everywhere. Projects to install green stormwater infrastructure were coded as "encourage" everywhere except in hazard areas and "conditional" in hazard areas because the Coastal Commission Guidance states sea level rise and extreme storms should be incorporated into their design. Projects to upgrade, expand, or add culverts under transportation infrastructure were coded as "encourage" in long-term or not at-risk areas. Projects to maintain, replace, or construct new culverts under transportation infrastructure was treated as maintenance or retrofitting of transportation infrastructure and was coded accordingly under A.31-32. Projects to replace stormwater infrastructure on military bases was treated as maintenance of non-coastal dependent critical infrastructure and coded accordingly under A.26-28. New stormwater infrastructure in hazard areas were considered under coastal-dependent critical infrastructure and coded accordingly under A.26-28. Projects to retrofit or construct new stormwater facilities in long-term risk areas that don't incorporate green infrastructure were coded as "allow." Maintaining or replacing non-green stormwater infrastructure was coded as "neutral." New stormwater facilities in areas not at risk were coded as "not addressed."

Outfalls/Intakes

E.03: Add policies to address water quality risks from wastewater treatment plants, septic systems, and ocean outfalls, including policies related to siting and design and retrofitting, relocating, or eliminating outfalls deemed "at risk." New intakes and outfalls were coded as "conditional." Intakes/outfalls that were relocated inland or retrofitted in other ways were coded as "encourage," while those relocated seaward in hazard areas are coded as contrary. Maintenance or replacement of existing intakes/outfalls were coded as "neutral."

Appendix 4-B: Comparing the Corps' California Districts

The distribution of projects across the recommended action and by goal for each district is shown in Figure 4-6. Overall, Los Angeles District authorized more projects related to the Coastal Commission Guidance (859 versus 733, respectively). Los Angeles District also authorized more "opposed" projects than San Francisco District (N=209, 59% versus N=146, 41%). Not surprisingly, there were only one goal for which Los Angeles District authorized fewer projects than San Francisco District: Soft Solutions (N=4, 2% versus N=8, 5%). For "opposed" projects, there were only one goal for which Los Angeles District authorized fewer projects than San Francisco District: Soft Solutions (N=4, 2% versus N=8, 5%).

San Francisco's larger number of projects associated with the Soft Solutions Goal was likely due to the single sand/gravel mining project in the coastal zone (prohibit) and three sand/gravel mining projects, two expanded or perpetuate existing dam projects, and two new dam projects, which were contrary and outside the coastal zone.

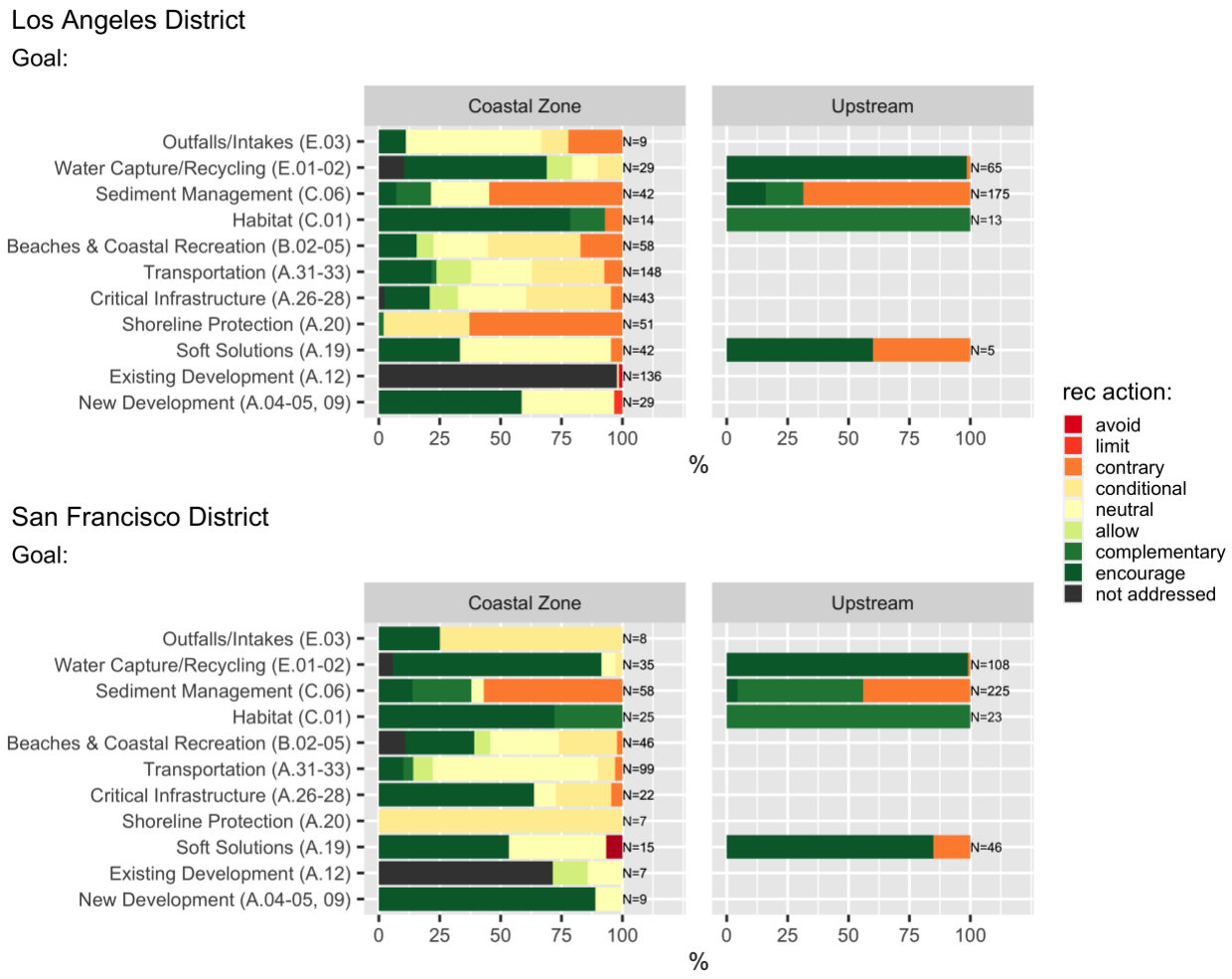

Figure 4-6: Percent of Corps-authorized projects in the coastal zone and in upstream watersheds relative to the goals and recommended actions in the Coastal Commission Guidance.

Of the goals in which San Francisco District had several opposing projects than Los Angeles District, a few are worth noting:

- San Francisco District authorized a higher percentage of complementary sediment management projects (C.06) and a lower number of contrary projects than Los

Angeles District. Los Angeles District authorized many more shoreline protection projects than San Francisco District (N=51 versus N=7, respectively).

- All seven shoreline protection projects authorized by San Francisco District were conditioned projects under the Coastal Commission Guidance, compared with 18 conditional projects and 32 contrary projects authorized by Los Angeles District. Most of these projects (81.2%) were to add additional riprap seaward of the existing hard shoreline stabilization which is protecting residential development in a hazard area.

- Another area of difference was in new development projects. Los Angeles District authorized the construction of 1 new utility line project for a residential development in a hazard area in 2021, which is a limited activity under the Coastal Commission Guidance.

- For the Beaches & Coastal Recreation Goal, San Francisco District authorized a higher percentage of encouraged projects and lower numbers of conditional and contrary projects than Los Angeles District. The conditional projects in Los Angeles District were to construct new facilities (hazard area) (9), modify existing facilities (hazard area) (9), and retrofit facilities (hazard area) (4) and included five projects involving hard shoreline stabilization. The 10 contrary projects in Los Angeles District all involved new hard shoreline stabilization.

- The differences between San Francisco and Los Angeles Districts were similar for projects categorized under the general critical infrastructure (A.26-28) goal. San Francisco District had a higher percentage of encouraged projects than Los Angeles

District and had a lower number of conditional projects. The number of contrary projects were about the same.

- For transportation and port infrastructure (A.31-33), Los Angeles District had a higher percentage of encouraged projects but also had a higher percentage of conditional and contrary projects. The conditional projects authorized by Los Angeles District were for port facilities (28), military facilities (10), and transportation facilities (6). The contrary projects were primarily for the expansion of transportation infrastructure in a hazard area (N=7).

CHAPTER 5: CONCLUSIONS

Ocean and coastal aquatic resources are important and valuable. However, current U.S. policy around managing these resources is fragmented. On the coasts, regulatory "red tape" makes responding to sea level rise difficult administratively as well as technically challenging. Ocean policy is piecemeal, reactive, and not designed to provide oversight for novel activities occurring offshore. And yet, sea level rise and new ocean-based industries are expanding, and the current regulatory framework is inadequate to allow this new growth while protecting ocean and coastal habitats.

The U.S. Army Corps of Engineers Regulatory Program (Corps), by virtue of its broad authority to regulate nearly all construction activities from the high tide line to the edge of the outer continental shelf, is the *de facto* federal agency to oversee these otherwise unregulated activities. Is the Corps making balanced decisions that allow development while protecting ocean and coastal resources? Is it using its authorities to support local plans for sea level rise adaptation? And is the status *quo*, in which the Corps is the agency providing federal oversight for otherwise unregulated activities, even appropriate, given the Corps' limited authority over the operation of the facilities is permits?

Overarching Findings

My research indicates the answer to all these questions is "no." The Corps' existing policies don't translate well to ocean and coastal habitats and as a result ocean and coastal habitats do not receive the same level of protection as freshwater habitats. In California, the Corps' existing General Permits are misaligned with the state's sea level rise adaptation goals, such that discouraged activities are easy to permit and supportive activities are hard to permit.

Finally, the Corps' authority is restricted in ways that make comprehensive regulation challenging at best, particularly in offshore waters.

Government oversight is often necessary to balance competing interests and ensure shared resources are protected. In a best-case scenario, legislators write a law that establishes a national policy for how some industry should be regulated and assigns the responsibility of implementing the new law to some agency. If this is absent and the industry is harming public trust resources, the public would complain. The status *quo* in the ocean is intermediate to these two extremes. Most new ocean industries need to get a permit from the Corps to construct their facility. During the permit review, the Corps goes through a public notice process and conducts consultations for threatened or endangered species or historic properties, as needed. But this review is limited to only the construction of the facility and its location as it relates to navigation. It does not cover the ongoing operation of the facility. This nuance is not intuitive, and the result is a public that often mistakenly believes the Corps is shirking its responsibility to regulate all aspects of the project.

For example, no federal agency is charged with the oversight of offshore aquaculture. There are no restrictions on what can and can't be cultured on a facility like this. If the permittee decides to grow an invasive species on the facility, the Corps has no authority to stop that from happening.

The Corps' limited authority carries over into its scope of analysis under the NEPA and other environmental laws (e.g., Section 7 of the ESA, and Section 106 of the National Historic Preservation Act). While the scope of analysis can encompass a slightly larger area than the Corps' geographic jurisdiction, it is still limited to only the direct and indirect effects *of the regulated activity* (33 CFR 325 Appendix B Item 7b).

Returning to our example of an offshore aquaculture project: The regulated activity is the installation of anchors, ropes, and floats at a specific location and of a specific size and configuration. The direct, indirect, and cumulative effects of this action that the Corps can consider include the long-term effects of the structure on the environment, the noise during construction, and the boat traffic to and from the site during construction only. During a Section 7 ESA consultation, NOAA may decide that limiting the speed of vessels travel to and from the site is the best way to prevent mortality of listed marine mammals or sea turtles, even though the Corps does not have any legal authority to tell the project proponent how fast they can drive their boats or enforce an infraction. NOAA may include these conditions in their biological opinion, but the Corps would not be able to enforce the condition beyond the construction period.

While the Corps has demonstrated its ability to grow in its environmental management role, the Corps still does not have the legal framework to require compensatory mitigation for the anticipated degradation a the aquatic resources under Section 10 of the Rivers and Harbors Act—even when the degradation such an activity would cause is well documented, such as is the case for shading of eelgrass beds by structures over water (B. Bernstein et al., 2011; Loflin, 1995; Shafer, 2002; Trevathan-Tackett et al., 2017). Rather, the Corps' regulations state that compensatory mitigation will only be required for "significant resource losses" (33 CFR 320.4(r)(2)). "Loss" means the loss of the water body, which doesn't typically result from an over-water (or in-water) structure. The 404(b)(1) Guidelines defines the degradation of a special aquatic site as a "significant resource loss," which gives the Corps a legal framework for requiring compensatory mitigation for degradation (rather than complete loss) of a site, but only when there is a discharge of "fill" (not structures or work under Section 10). Since many Section-10-only activities occur in ocean or tidal waters, this creates a system where the Corps is far less likely to require compensatory mitigation for impacts in ocean and tidal waters. In fact, I found

the compensatory mitigation rate for ocean and tidal impacts to be six times less than the rate for freshwater impacts in coastal counties (Chapter 3).

It is concerning that an impact in a freshwater system is still four times more likely to require compensatory mitigation than an impact in an ocean or tidal system, even after accounting for differences that make ocean and tidal impacts less likely to cause substantial resource loss. For example, when the site was not a "special aquatic site" the compensatory mitigation rate for an impact to a beach, unvegetated rocky intertidal area, kelp forest, or soft bottom subtidal habitat; 40 CFR 230.3(m)), was 49 percentage points lower than the compensatory mitigation rate for an impacts to a stream (excluding riffle and pool complexes) or lake, even when both activities involved a permanent loss, was regulated under Section 404, and was authorized with a Standard Permit (Chapter 3). This discrepancy might indicate an undervaluation of ubiquitous ocean and coastal habitats that are devoid of vegetation or macroalgae.

Even if there is evidence of "significant resource loss" from an impact in an ocean or tidal system, approving compensatory mitigation for this loss is very challenging. The 2008 Mitigation Rule requires all mitigation sites (permittee-responsible, mitigation bank, or in-lieu fee) be protected through a real estate instrument or other similar mechanism (33 CFR 332.7(a) and 33 CFR 332.8(t)), while if the site is on government property, federal facility management plans or integrated natural resource management plans can suffice (33 CFR 332.7(a)). For a public trust resource, like the ocean, this provision of the Rule has restricted compensatory mitigation to tidal wetlands and estuaries that can be treated as property (U.S. EPA, 2023). The site protection requirement in the Rule can also lead to absurd situations, such as when a mutable habitat like eelgrass shifts to just outside the legally defined mitigation area (personal observation). One mechanism that could provide solution would be to co-locate a compensatory

mitigation site within a marine protected areas or sanctuary. However, this approach is not without legal hurdles and controversy.

Once a compensatory mitigation plan can be agreed do, there are still challenges to achieving success. For example, the success of eelgrass mitigation depends on outside factors such as the water quality entering the site (Altman et al., 2023). But again, the 2008 Mitigation Rule is not constructed to easily allow this kind of "out-of-kind" compensatory mitigation, even if the result would be the improved health of the affected habitat. For example, the definition of "out-of-kind" in the 2008 Mitigation Rule "means a resource of a different structural and functional type from the impacted resource" (33 CFR 332.2 "Out-of-kind"). Furthermore, out-of-kind mitigation can only be permittee-responsible (i.e., cannot involve a Third-Party Provider like a Mitigation Bank) and can only be considered when practicable in-kind alternatives do not exist (33 CFR 332.3(b)(6)).

One of the complaints against the Corps' compensatory mitigation policies before the 2008 Mitigation Rule was that it was requiring mitigation on paper, but in practice the mitigation requirements were not being enforced. A similar statement can be made now for the Corps' regulation of ocean and coastal habitats. The act of issuing a permit and conducting other environmental reviews gives the appearance of comprehensive government oversight of these projects when the review is actually very focused. This is not a deficiency in the Corps' permitting process, but rather due to the lack of comprehensive ocean policy at the federal level.

An alternative approach for eelgrass mitigation is the idea of comprehensive eelgrass management plans. This concept was created by NOAA in the California Eelgrass Mitigation Policy (NOAA Fisheries, 2014) to support their consultations with the Corps for adverse effects to eelgrass as "essential fish habitat" (50 CFR Part 600 Subpart J). NOAA's Mitigation Policy is

similar to the Corps' 2008 Mitigation Rule in that it establishes a goal of "no net loss of eelgrass habitat functions" and outlines a process for requiring compensatory mitigation. One of the biggest differences between the CEMP and the 2008 Mitigation Rule is this concept of comprehensive management.

An approved comprehensive management plan allows impacts and compensatory mitigation to be assessed on a system-wide basis, rather than project by project (NOAA Fisheries, 2014). To date, only one municipality in California has implemented this approach. Newport Beach finalized their plan in 2015 (City of Newport Beach, 2015) and linked the plan to a Corps Regional General Permit (RGP 54) for maintenance dredging. Under the plan, the city approves the use of the plan for specific projects, ensures compliance with the plan, and gathers data on eelgrass. The plan establishes a procedure for determining annual allowable impacts to eelgrass (by area) for covered activities within pre-defined zones. It also establishes best management practices to be required based on the eelgrass abundance estimates, and an adaptive management, restoration, and public outreach program (City of Newport Beach, 2015).

The advantage of this plan is that it creates incentives to encourage stewardship of eelgrass among dock owners and the city, such as reduced permitting costs (the city's biannual eelgrass surveys can be used instead of a project specific survey), reduced mitigation costs for individual dock owners (compensatory mitigation is not required for covered impacts), and increased flexibility (more eelgrass means more projects can be covered by the plan). The plan also contains penalties for loss of eelgrass to dissuade lack of stewardship, such as additional best management practices, additional mitigation requirements for the city, and a reevaluation of the plan itself (City of Newport Beach, 2015).

Other findings

The Corps' California Districts can collaborate more with the state's ocean and coastal management agencies. In California, the Coastal Commission (the state's Coastal Zone Management Agency), has never granted a blanket Federal Consistency Certification to any of the Corps' General Permits that apply to the state. Similarly, the State Water Resources Control Board provides general Water Quality Certifications (under Section 401 of the Clean Water Act) to far fewer of the Corps' General Permits than any other state. The result is one of the most complex regulatory environments in the country. This lack of cooperation between the Corps and the State also leads to misalignment between some of the state's environmental goals and the Corps' General Permits (Chapter 3). While the Corps should not try to influence state or local policy, the Corps can work with the State to further common goals. For example, New England District suspends all Nationwide permits and instead issues General Permits tailored to each state's environmental policies so that the state can provide blanket federal consistency certification (New England District, 2021, 2022). The result is permitting efficiency for the Corps and a simplified process for the project proponent (New England District, 2022).

Overarching Recommendations

Below are a few overarching policy recommendations to supplement the ones given in my specific chapters.

- The Corps' permit data can provide robust information about the Corps Regulatory Program, but also has the potential to provide insight into the effects of other types of policy changes. For example, I observed a decreasing trend in projects opposed to the California Coastal Commission's Sea Level Rise Policy Guidance (Guidance) and an

increasing trend in projects in support of this same Guidance, that started around the time that the Guidance was written (Chapter 3). The Corps should provide a way to download its permit data to the public and should put information about how the data are created and caveats about its use on a publicly available website.

- Corps Districts should be proactive within the constraints of the existing legal framework to protect ocean and coastal resources. Districts can collaborate with state permitting agencies to issue General Permits with state authorizations for habitat restoration or engineered-with-nature activities. Collaboration with state agencies may also yield creative ways to provide site protection for compensatory mitigation in the state's ocean waters or identify new types of in-lieu-fee programs targeted at activities such as kelp restoration or marine debris removal.

- The Corps' California Districts should encourage other municipalities to adopt comprehensive eelgrass management plans that can be paired with regional General Permits to provide protection for eelgrass, allow ongoing port and harbor activities to continue, and circumvent the drawbacks of the 2008 Mitigation Rule as applied to eelgrass mitigation.

- Congress should enact a national ocean policy per the recommendations of the Joint Ocean Commission Initiative and U.S. Commission on Ocean Policy. Congress should also give NOAA regulatory authority over offshore aquaculture.

Data Gaps & Future Studies

What follows are sets of questions and suggestions, which identify data gaps and areas of future study to support the policy recommendations made in this dissertation.

Importance of Soft-Bottom Benthic Habitats

- How are soft bottom subtidal habitats of importance to the human or marine environment?

- How should degradation (or restoration) of this habitat type be measured?

Effects of Offshore Facilities on Open Ocean Habitats

- Do offshore structures facilitate the spread of invasive marine species, by acting as steppingstones for larval transport?

- Do offshore kelp aquaculture facilities act as fish attracting devices? Do they measurably alter larval recruitment at nearshore kelp forests?

- In what other specific and measurable ways do offshore facilities degrade open ocean habitat?

Alternative Approaches to Compensatory Mitigation

- Develop a system to equate functions and services across different marine and estuarine habitats. For example, if a project were to degrade 0.25 acre of eelgrass and

the environmentally preferable option is to restore a nearby kelp forest, what area of kelp forest should be restored in compensation?

- Develop a system to equate lost area of eelgrass with water quality improvements in the watershed.

Alternatives to Hard Stabilization

- Develop bioengineered bank stabilization techniques that can be used in high energy, steep gradient streams.

- Develop living shoreline stabilization techniques that can be used in high energy, open coast environments.

- Are there situations in which beach nourishment projects have no more than minimal adverse effects on the marine environment?

- Quantify the adverse effects of hard shoreline stabilization on the marine environment. Assess the conditions under which these adverse effects are more than minimal.

Conclusions

An age of ocean expansion is here. With it comes new challenges. Even if the U.S. Government doesn't enact comprehensive ocean policy, the Corps should use its regional authority to improve its protection of ocean and coastal resources. The ocean is a critical

resource and needs the same level of protection as freshwater resources. I plan to leverage the research in this dissertation and my continued professional development to assist the Corps in preparing for this new challenge by doing a better job protecting ocean and coastal resources.

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