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ENVIRONMENTAL CONSEQUENCES



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INTRODUCTION

This “Environmental Consequences” chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this EIS. This chapter also includes a summary of laws and policies relevant to each impact topic, definitions of intensity definitions (minor, moderate, and major), methods used to analyze impacts, and methods used for determining cumulative impacts. As required by CEQ regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in table 2-6 in “Chapter 2: Alternatives.” The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in “Chapter 3: Affected Environment.”

METHODOLOGY FOR ASSESSING IMPACTS

The following elements are used in the general approach for establishing intensity definitions and measuring the effects of the alternatives on each resource category:

- General analysis methods as described in guiding regulations, including the context and duration of environmental effects
- Definitions used to describe the level of impact resulting from each alternative
- Basic assumptions used to formulate the specific methods used in this analysis
- Methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting park resources

These elements are described in the following sections.

GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ guidelines and Director’s Order 12 procedures (NPS 2001b). This analysis incorporates the best available scientific literature applicable to the region and setting, the resources being evaluated, and the actions being considered in the alternatives. “Chapter 1: Purpose of and Need for Action” provides a summary of the types of references used in preparing the impact analysis.

Baseline for Comparison

For the purposes of this document, the term “baseline” refers to the condition against which a change is being compared for assessment of impact in this EIS. It should not be confused with other definitions of the term. The baseline against which the no-action alternative is assessed is generally existing conditions. This is consistent with DOI regulations guiding the implementation of NEPA, which state:

“The analysis of the effects of the no-action alternative may be documented by contrasting the current condition and expected future condition should the proposed action not be undertaken with the impacts of the proposed action and any reasonable alternatives.” 43 CFR 46.415 (b)(1)

The action alternatives, on the other hand, are generally assessed using the no-action conditions as the baseline condition. In other words, the analysis of the action alternatives may be documented by contrasting the expected future conditions under each action alternative to the expected future conditions under the no-action alternative.

ANALYSIS PERIOD

For the purposes of this analysis, it is assumed that after expiration of the SUP (whether in 2012 or 2022), the commercial shellfish operation would cease to operate and the congressionally designated potential wilderness would be converted to congressionally designated wilderness. The impact analysis for the no-action alternative (alternative A) focuses on describing the expected impacts of the removal of the shellfish operation beginning in 2012 in a detailed manner. For the action alternatives (alternatives B, C, and D), the impact analysis focuses on describing the impacts associated with the issuance of a 10-year SUP for shellfish operations in Drakes Estero. A brief discussion of impacts upon expiration of the SUP in 2022 is included to give the reader a sense of the anticipated impacts beyond 2022. For some impact topics, this prediction is fairly straightforward, as the impacts (both adverse and beneficial) of the shellfish operation would cease immediately upon expiration of the SUP. For other impact topics, the prediction is less certain, as some impacts are expected to continue beyond 2022, but would likely diminish in intensity over time.

Geographic Area Evaluated for Impacts (Area of Analysis)

The geographic area (or area of analysis) for the EIS includes DBOC onshore and offshore facilities and operations in and adjacent to Drakes Estero (see figures 1-3 and 1-4). The area of analysis is extended for socioeconomic resources, as discussed further under that impact topic in this chapter.

Type of Impact

The following terms are used for all impact topics (the terms “impact” and “effect” are used interchangeably throughout this document).

Beneficial:	A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
Adverse:	A change that moves the resource away from a desired condition or detracts from its appearance or condition.
Direct:	An impact that is caused by an action and occurs at the same time and place.
Indirect:	An impact that is caused by an action but is later in time or farther removed in distance, but still reasonably foreseeable.

Duration of Impact

The duration of an impact defines how long the impact may last following implementation of an action. Wherever possible, the analysis quantifies the actual length of the expected impact. Impacts are defined as either short-term or long-term and are not generally both. The following terms are used for all impact topics to allow for easy summarization.

Short-term:	Impacts that last a relatively brief time following an action and/or are temporary in nature. Short-term impacts typically are less than 1 year in duration.
Long-term:	Impacts that last a relatively long time following an action and/or may be permanent. Long-term impacts typically are longer than 1 year in duration.

Context of Impact

Context is the setting within which an impact occurs and can be local or regional. The following terms are used for all impact topics.

Local:	The impact would occur within the general vicinity of the project area.
Regional:	The impact would affect localities, cities, or towns surrounding the Seashore.

INTENSITY DEFINITIONS

Determining intensity definitions is a common method in applying Director's Order 12 (NPS 2001b). These definitions provide the reader with an idea of the magnitude of a given impact on a specific impact topic. Intensity definitions are derived from relevant standards based on law, policy, regulations, NPS *Management Policies 2006*, scientific literature and research, or best professional judgment. Intensity definitions may vary by impact topic; therefore, they are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for minor, moderate, and major adverse impacts. Beneficial impacts are addressed qualitatively throughout the analysis.

ASSUMPTIONS

A number of guiding assumptions were made to provide context for the impact analysis. As explained in Chapter 1, a main resource used in development of this EIS was the NAS report, *Shellfish Mariculture in Drakes Estero, Point Reyes National Seashore, California* (NAS 2009). The report provides an intensive

review of pertinent scientific literature on this subject. As such, there is much overlap between the literature cited in that document and the references used to support this EIS. Pertinent to the analysis in this chapter are a few key considerations:

- The conclusions in the NAS report are based on 2008-2009 levels of DBOC production and operational practices. Production levels for 2008-2009 representing the current levels of production referenced by the NAS are approximately 450,000 lbs of shellfish, with Manila clams permitted only within the 1-acre Lease M-438-02 (Area 2). The actual footprint of the racks and bags on the bottom of Drakes Estero in 2008 was estimated to be less than 30 acres.
- The 2009 NAS report does not provide a definition or detection threshold for what a “major” adverse ecological effect would be in this context, nor does it indicate that the NAS use of an impact qualifier (e.g., “major”) is consistent with NEPA standards.
- It should also be noted that archeological and historical sources that pertain directly to the presence or absence of oysters in Drakes Estero prior to the establishment of an oyster operation in the 1930s were not considered in the NAS study.

In addition, the following assumptions are based on the descriptions of the alternatives provided in chapter 2.

Alternative A

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. Actions associated with this alternative that have the potential to impact resources include:

- DBOC would be responsible for the removal of certain buildings and structures and all personal property (including any improvements made to the area since 1972).
- DBOC would be responsible for removal of commercial shellfish operations infrastructure within the 138 acres of established growing areas within Drakes Estero. This includes:
 - All 95 racks would be removed, including approximately 4,700 posts (2-inch by 6-inch boards) and more than 179,000 linear feet (approximately 5 miles) of pressure-treated lumber would be removed (this is anticipated to take one to two months outside the harbor seal pupping season, March 1 to June 30).
 - All bags would be removed from Drakes Estero, including up to 88 acres of bottom bags. This is estimated to take approximately two weeks.
- DBOC operations, including motorboat use and the operation of pneumatic hammers/drills would cease.

Alternative B

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within Drakes Estero. Actions associated with this alternative that have the potential to impact resources include:

- Onshore facilities and infrastructure, including previously unpermitted infrastructure, would remain. This would be generally consistent with what is currently present on the site.
- The total acreage of the SUP area, both onshore and offshore, would be approximately 1,083 acres.

- Offshore: 1,078 acres (area 1: 1,077 acres, area 2: 1 acre)
- Onshore 4.3 acres
- With the exception of slight reductions to Bed 17 (which currently extends into the seal protection areas) consistent with DBOC's requests, all existing shellfish growing areas would be included in the SUP area and would remain.
- DBOC would cultivate approximately 138 acres of Drakes Estero using a combination of hanging and bottom culture (4 acres of Bed 17 would be removed).
- DBOC would continue to conduct hanging culture using 95 wooden racks for cultivation, which total approximately 5 miles when laid end-to-end (also expressed as 7 acres), within Drakes Estero.
 - DBOC would repair or replace approximately 5 percent of rack structures annually, resulting in up to 1,285 feet of rack and 8,900 feet of new lumber installed per year.
- DBOC would continue to conduct bag culture in up to 84 acres of Drakes Estero (in the past 2 years, for example, approximately 22 acres of bags were planted annually).
- Pacific oysters, European flat oysters, and Manila clams could be cultivated in documented shellfish growing areas within Area 1. Purple-hinged rock scallops could only be grown in the existing 1-acre plot, Area 2.
- Shellfish production would not exceed 600,000 pounds annually. This level is consistent with 2010 production levels.
- DBOC would operate motorized boats per a NPS-approved vessel transit plan.
 - The total area of boat use estimated by a compilation of available data is approximately 740 acres.
 - DBOC currently operates two motorboats within Drakes Estero: one is 16 feet long with a 20-horsepower 4-stroke engine, while the other is 20 feet long with a 40-horsepower 4-stroke engine.
 - These boats operate up to 8 hours per day, 6 days per week, making approximately 12 round trips per day (DBOC [Lunny], pers. comm., 2011h).
- NPS and CDPH would evaluate alternatives to the existing water sampling site within the seal protection area.
- DBOC operations would be subject to the harbor seal protection protocol:
 - Boat travel and general operations, including placement of bags, moorings, and installation of floating racks, is prohibited within the established harbor seal protection areas.
 - Closure of the lateral channel during the harbor seal pupping season (March 1–June 30).
 - Maintenance of a 100-yard buffer from any hauled-out harbor seal.
- DBOC would replace the existing dock, work platform, and associated structures subject to NPS final review and approval due to damage from the March 2011 storm event.
 - New wooden floating dock (12 feet by 32 feet)
 - New concrete work platform (including sediment basin approximately 55 feet by 24 feet)
 - New wooden ramps to connect the dock and work platform
 - New conveyor
 - New washing system
- Dredging would take place at the outset of the permit term in an area approximately 30 feet wide by 60 feet long and to a depth of approximately 3 feet. DBOC estimates that the total volume of dredged material would be 100 cubic yards (DBOC 2011dⁱ); although straightforward calculations indicate that it would be 200 cubic yards.
- Staff housing would be provided (14 bedrooms)

- 2 permanent houses
- 3 mobile homes
- DBOC would be required to pay the U. S. fair market value for the use of federal property, which includes onshore and offshore areas within the permit boundaries, as mandated by section 124.
- By November 30, 2022, DBOC would be required to remove certain buildings and structures and all of its personal property and to undertake steps to restore the area to good order and condition.

Alternative C

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within Drakes Estero. The actions associated with this alternative that have the potential to impact resources are the same as those described under alternative B, with the following exceptions:

- In contrast to alternative B, onshore infrastructure would be slightly reduced by removing unpermitted and nonessential facilities.
- The total acreage of the SUP area, including both offshore and onshore areas, would be approximately 901 acres. Those acres not included in the permit area under this alternative are not currently available for production due to state water quality harvest prohibitions.
 - Offshore: 897 acres (Area 1: 896 acres, Area 2: 1 acre)
 - Onshore 4.3 acres
- Shellfish production would not exceed 500,000 pounds annually (inclusive of all harvested species). This represents an approximately 10 percent increase above the average annual DBOC production for the period 2007 to 2009, which was approximately 454,000 pounds per year. Pacific oysters and European flat oysters could be grown on documented shellfish growing areas within the main offshore permit area, Area 1. Manila clams and purple-hinged rock scallops could only be cultivated in the existing 1-acre plot, Area 2.
- NPS would evaluate future requests for operational and infrastructure changes from DBOC taking into consideration consistency of the proposed changes with 2008 conditions and levels of production.

Alternative D

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within Drakes Estero. The actions associated with this alternative that have the potential to impact resources are the same as those described under alternative B, with the following exceptions:

- Two development proposals submitted by DBOC are evaluated at the conceptual level in this EIS. Additional planning, design, environmental compliance, and approval would be required prior to proceeding with construction of proposed new facilities. Additional NEPA compliance would be required.
 - Option 1: New facilities include a 2-story, 7,600-square-foot processing and interpretive center; 6,400-foot indoor setting tank; outdoor aquarium; garage; employee parking; staff housing remains as is.

- Option 2: New facilities include 2,625-square-foot multipurpose building; no staff housing identified.
- New 1,050-foot water intake pipe installed into Drakes Estero to serve new oyster processing facilities.
- The total acreage of the SUP area, including both offshore and onshore areas, would be approximately 1,087 acres, which incorporates the boundary adjustment requested by DBOC.
 - Offshore: 1,082 acres
 - Onshore: 4.3 acres
- Shellfish production would not exceed 850,000 pounds annually (inclusive of all harvested species). This production level is based on DBOC's projections of maximum production levels (submitted to CCC). This level of production would be approximately 40 percent greater than the production limit in alternative B and 70 percent greater than alternative D.
- Pacific oysters, European flat oysters, Manila clams, Olympia oysters, and purple-hinged rock scallops could be cultivated in documented shellfish growing areas within the offshore permit area. The 1-acre plot (Area 2) would not be maintained as a distinct shellfish growing area.
- Due to the increased levels of production:
 - Boat traffic/number of boat trips may increase.
 - Acreage of bags planted would be at least 22 acres; not exceeding 84 acres in cultivation at any given time.
- Due to the presence of new facilities and increased production at DBOC, an increase in sales and visitation is assumed.
- By November 30, 2022, DBOC would be responsible for the removal of all infrastructure developed under this alternative, as well as all personal property. DBOC would be required to restore the area to good order and condition.

CUMULATIVE IMPACT ANALYSIS METHODOLOGY

The CEQ regulations that implement NEPA require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as impacts which result when the impact of the proposed action is added to the impacts of other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions (40 CFR 1508.7). These impacts can be beneficial or adverse. Cumulative impacts are considered for all alternatives, including alternative A.

The analysis of cumulative impacts was accomplished using four steps:

Step 1—Identify Resources Affected: Fully identify resources affected by any of the alternatives.

Step 2—Set Boundaries: Identify an appropriate spatial and temporal boundary for each resource.

Step 3—Identify Cumulative Action Scenario: Determine which past, present, and reasonably foreseeable future actions to include with each resource.

Step 4—Cumulative Impact Analysis: Summarize the impacts of these other actions (x) plus the impacts of the proposed action (y) to arrive at the total cumulative impact (z).

Past, Present, and Reasonably Foreseeable Actions

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other past, present, or reasonably foreseeable future projects and plans at the Seashore. The following projects were determined to be potential contributors to cumulative impacts on the affected resources in conjunction with the potential impacts of the alternatives presented in this document. The past actions considered in this EIS are bounded by approximately five years.

Restoration of the Developed Onshore Area Following SUP Expiration. Following expiration of either the existing NPS authorizations in 2012 or a new SUP in 2022, the NPS would undertake actions to maintain and restore natural conditions at the developed onshore area. Although temporary structures and personal property associated with the current mariculture activities would be removed as part of all alternatives, permanent structures (such as the main house and the processing plant) would remain, as they are already owned by NPS. The Seashore would evaluate restoration of natural shoreline conditions, including removal of fill from wetland areas and restoration of tidal conditions to the pond northwest of the developed area. The Seashore would relocate public access and facilities to a location more appropriate with anticipated sea-level rise, as necessary. The following resources could be impacted by the proposed restoration activities: wetlands, wildlife and wildlife habitat (fish and birds), special-status species, coastal flood zones, water quality, soundscapes, and NPS operations.

Kayaking. Recreational use of nonmotorized watercraft (mostly kayaks) is a popular use of Drakes Estero. Thirteen commercial operators are currently authorized by the Seashore to provide kayak tours within Drakes Estero. Of those authorized, only a small number currently offer tours within Drakes Estero (an estimated two or three of the companies). In addition, visitors to the Seashore also have access to Drakes Estero for kayaking as individuals. Research suggests that kayaking may cause harbor seal flushing (Becker, Press, and Allen 2011; Suryan and Harvey 1999; Calambokidis et al. 1991), bird flushing (Kelly et al. 1996), and could also impact harbor seal migratory patterns during pupping season (Suryan and Harvey 1999). The NPS would evaluate recreational use levels within Drakes Estero and may limit use by permit. Increased kayaking and other nonmotorized watercraft within Drakes Estero has the potential to impact wildlife and wildlife habitat (harbor seals and birds), special-status species, soundscapes, visitor experience and recreation, and socioeconomic resources.

Monitoring/Managing Invasive Species. Monitoring and management of invasive species within the Seashore is an ongoing effort. In particular, the annual survey and response for *Spartina* is ongoing. Additionally, there is now documentation of *Didemnum* growing on the ends of eelgrass blades and potential naturalization of Manila clam (Grosholz 2011b), indicating that increased monitoring and management of *Didemnum* and Manila clam may be necessary to protect native eelgrass habitat and benthic populations within Drakes Estero. NPS would evaluate treatment methods to control *Didemnum* and nonnative Manila clam (no actions currently occur). Ongoing monitoring and management activities may be conducted as appropriate.

The Seashore has been using prescribed fire and mowing treatments to control the nonnative plant Scotch broom (*Cytisus scoparius*) in this fire management unit since 1993 and plans to continue with these treatments (NPS 2006b). These activities are ongoing in 2011, with a project to control broom in the area immediately east of the access road through mowing and controlled burn activities.

Monitoring and/or managing invasive species within the project area could impact the following resources: wetlands, eelgrass, wildlife and wildlife habitat (benthic fauna), wilderness, and NPS operations.

Fire Management Plan. The current fire management plan for the Seashore was published in 2006 (Fire Management Plan: Operational Strategy). The purpose of the fire management plan is to provide a framework for all fire management activities within the Seashore and the North District of Golden Gate National Recreation Area (NPS 2006b). Such activities include prevention and suppression of unplanned ignitions, prescribed fire, fire education and information, monitoring, fire and fuels research, and mechanical fuels treatments. The project area is within the Drakes Estero fire management unit, which is one of three fire management units (out of 11 total within the Seashore) that were established primarily for resource management reasons. Fire management planning within the Seashore has the potential to impact the following resources: water quality and NPS operations (NPS 2006b).

Maintenance of Red-legged Frog Ponds. The Seashore will continue to evaluate and maintain ponds adjacent to Drakes Estero that provide critical breeding habitat for the federally threatened California red-legged frog. As appropriate, maintenance activities would be conducted by NPS staff or contractors to ensure the stability of small earthen dams. These ponds were established for grazing operations and now provide critical breeding habitat for this federally listed species. In all cases, the NPS would consult with USACE and USFWS prior to conducting any work. Continued maintenance of red-legged frog ponds has the potential to impact the following resources: special-status species and NPS operations.

Moving the Vault Toilet away from the Shoreline. The vault toilet would be moved away from the coastal flood hazard zone to a location more appropriate to protect water quality and shoreline resources. A specific location for the vault toilet would be determined through a separate planning process. Moving the vault toilet away from the shoreline could impact the following resources: coastal flood zones, water quality, and NPS operations.

Ranching Operations. Six cattle ranches are located within the Drakes Estero watershed. According to Baltan (2006) and Zubkousky (2010) the primary source of nonpoint-source pollution within Drakes Estero is from cattle waste from ranches within the Drakes Estero watershed. Specifically, fecal coliform levels in most of Drakes Estero have been shown to intermittently rise after rain events associated with runoff from pastures within the watershed (Baltan 2006; Zubkousky 2010). Rainfall closures have been required within Drakes Estero for more than a decade. Continued ranching in the vicinity of the project area has the potential to impact the following resources: water quality and socioeconomic resources.

Human-cause Noise Sources (Other than DBOC). Other ongoing sources of noise in the Estero (DBOC-related noise is evaluated as an impact topic) such as overflights and use of cars along Sir Francis Drake Boulevard, has the potential to impact resources in and around the project area. These actions could impact wildlife and wildlife habitat (seals and birds), soundscapes, and visitor experience and recreation.

Planning and Management Activities. Past, present, and future planning and management activities at the park include the following projects/activities:

- New GMP
- *Adapting Drakes Beach Visitor Access Facilities to Accommodate Anticipated Coastal Change to Improve Natural Coastal Process*
- *Abbotts Lagoon Coastal Dune Restoration Project*
- Regular trail maintenance
- Approval of research permits

Any action proposed to take place within wilderness, such as research or park management, is subject to a minimum requirement analysis as described in the Minimum Requirements Decision Guide (developed by the interagency Arthur Carhart National Wilderness Training Center) and NPS *Management Policies 2006* (NPS 2006d, section 6.3.5). This concept is applied as a two-step process that determines (1) whether or not the proposed action is appropriate or necessary for administration of the area as wilderness and does not cause significant impact on wilderness resources and character, in accordance with the Wilderness Act, and (2) the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized (NPS 2006d).

These actions could impact eelgrass, wildlife and wildlife habitat (harbor seals and birds), special-status species, soundscapes, wilderness, visitor experience and recreation, and NPS operations.

Coastal Watershed Restoration: Geomorphic Restoration Project. Completed in 2008, the purpose of the *Coastal Watershed Restoration Program: Geomorphic Restoration Project* was to restore natural conditions and increase estuarine habitat at Point Reyes (NPS 2004a). The project was designed to reduce the maintenance demands at Point Reyes, to eliminate the risk of catastrophic failure of culverts and dams, and to increase sustainability, both operationally and ecologically, within the small coastal watersheds. Restoration efforts included the removal of a 25-foot-high, 100-foot-wide road prism from the Muddy Hollow Trail crossing of Glenbrook Creek, a nonconforming structure in the Philip Burton Wilderness, and expansion of tidal habitat to portions of Estero de Limantour through the removal of Muddy Hollow Dam and Limantour Beach Pond Dam. Each of the sites included in the project had been identified as impeding or blocking access to watersheds that support, or have the potential to support, federally threatened coastal California steelhead and Coho salmon (NPS 2004a). Resources impacted by the *Coastal Watershed Restoration: Geomorphic Restoration Project* include wetlands, eelgrass, wildlife and wildlife habitat (benthic fauna, fish, and birds), special-status species, water quality, wilderness, and NPS operations (NPS 2004a).

Coastal Watershed Restoration: Drakes Estero Road Crossings Improvement Project. The *Drakes Estero Road Crossings Improvement Project*, completed in 2008, was designed to replace or remove culverts and fish passage problems at six sites within the Drakes Estero watershed. The culverts were designed to facilitate restoration of natural hydrologic and geomorphic processes and fish passage within the watersheds, which are known to support threatened and endangered aquatic species, including the federally listed central California steelhead and potentially the endangered Coho salmon. The project also was undertaken to make road maintenance operations more sustainable (NPS 2004b). Resources impacted by the *Drakes Estero Road Crossing Improvement Project* include wetlands, eelgrass, wildlife

and wildlife habitat (benthic fauna, fish, and birds), special-status species, water quality, and NPS operations (NPS 2004b).

California Aquaculture Programmatic Environmental Impact Report (PEIR). A California Aquaculture Programmatic Environmental Impact Report (PEIR) is being developed for CDFG, which would alter management of CDFG's aquaculture leasing program along the coast (CA.gov 2010). Although CDFG currently regulates the stocking of aquatic organisms, brood stock acquisition, disease control, and the importation of aquatic organisms into the state under Division 12 of the Fish and Game Code, (as described in chapter 1), the agency does not have a well-defined aquaculture program. The management framework proposed by CDFG would include:

- new requirements for providing baseline information with applications for proposed new leasing sites
- new siting criteria to be used by CDFG when reviewing applications for new leases
- new lease application requirements and operational requirements designed to avoid significant environmental effects
- potential restrictions on the number of new leases for finfish cultivation that would be allowed in the next 10 years

Implementation of actions associated with the PEIR has the potential to impact socioeconomic resources.

Expansion of Mariculture within Humboldt Bay, California. In July 2011, the Board of Supervisors of Humboldt County voted to approve a \$200,000 grant to allow expansion of mariculture within Humboldt Bay. The grant has been awarded under the Headwaters Fund and will be provided to the Humboldt Bay Harbor, Recreation and Conservation District. The Headwaters Fund was established in 2003 to provide support for economic and community development in Humboldt County and, in part, provides grants for projects that would benefit base industries in the county (County of Humboldt 2011). Such grants are typically accepted annually and each grant averages between \$200,000 and \$300,000. The recently approved funding will be dedicated to conducting pre-permitting studies with the intent of expanding potential shellfish growing areas within Humboldt Bay (Greenson 2011). The intent is that such studies would expand the acres available for mariculture operations, thereby expanding the mariculture industry in Humboldt Bay, which currently provides approximately 70 percent of the fresh oysters consumed in California (Greenson 2011; Humboldtmade.com 2011). Expansion of mariculture within Humboldt Bay has the potential to impact socioeconomic resources.

Change in NOAA Aquaculture Policy. Domestic aquaculture currently accounts for approximately 5 percent of the seafood consumed in this country, approximately 65 percent of which is shellfish. Additionally, 84 percent of the seafood imported to the U.S. is from foreign aquaculture. In an effort to reduce these imports and support the U.S. economy, national sustainable marine aquaculture policies have been established by the U.S. Department of Commerce and NOAA (NOAA 2011a). These policies have been specifically designed to support a national approach to sustainable aquaculture that will meet the increased demand for healthy seafood in the U.S.; support coastal communities, including commercial and recreational fisheries; and restore vital species and habitat. Focused efforts will include encouraging and fostering sustainable aquaculture that increases the value of domestic aquaculture production and creates

American business, jobs, and trade opportunities (NOAA 2011a). A change in NOAA aquaculture policy has the potential to impact socioeconomic resources.

Economic Trends. The current economic recession is having a dampening effect on the national and local economy; however, despite the poor economic conditions, visitation to the Seashore has remained generally steady, declining only 8 percent since 2008. Unemployment rates in both the state and Marin County have increased since 2008 (U.S. Department of Labor 2011). Over time, increasing population and economic opportunities should provide beneficial impacts to the economy of Marin County. Past, present, and reasonably foreseeable economic trends have the potential to impact socioeconomic resources.

CDFG Marine Life Protection Act Initiative. In May 2010, the MLPA initiative took effect along the north-central coast of California (CDFG 2010c). A total of 21 marine protection areas were established in coastal areas between Alder Creek near Point Arena in Mendocino County to Pigeon Point in San Mateo County. Pursuant to the MLPA, California's marine protection areas must periodically be reexamined and redesigned "to increase their coherence and effectiveness at protecting the state's marine life, habitat, and ecosystems" (CDFG 2010c). A number of marine protection areas were established along the coast of the Seashore. Two of these areas are located within the project area including the Drakes Estero State Marine Conservation Area (SMCA) and Estero de Limantour State Marine Reserve (SMR). The Drakes Estero MPA prohibits the take of any living marine resource except for recreational take of clams and the commercial aquaculture operations under valid State Water Bottom Lease and permit (CDFG 2010c). The Estero de Limantour SMR prohibits take of any living marine resource (CDFG 2010c). Ongoing efforts associated with the MLPA have the potential to impact the following resources: eelgrass, wildlife and wildlife habitat (benthic fauna, fish, harbor seals, and birds), special-status species, and wilderness (CDFG 2010c).

Table 4-1 provides a summary of the cumulative analysis study area for each impact topic, as well as the past, present, and reasonably foreseeable future actions that could affect each impact topic.

TABLE 4-1. CUMULATIVE IMPACTS ANALYSIS ACTIONS

Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Wetlands			
Project area	<ul style="list-style-type: none"> Monitoring/managing invasive species Coastal Watershed Restoration: Geomorphic Restoration Project Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> Monitoring/managing invasive species 	<ul style="list-style-type: none"> Restoration of the developed onshore area following SUP expiration Monitoring/managing invasive species
Eelgrass			
Drakes Estero	<ul style="list-style-type: none"> Monitoring/managing invasive species Planning and management activities Coastal Watershed Restoration: Geomorphic Restoration Project Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> Monitoring/managing invasive species Planning and management activities CDFG MLPA initiative 	<ul style="list-style-type: none"> Monitoring/managing invasive species Planning and management activities CDFG MLPA initiative
Wildlife and Wildlife Habitat: Benthic Fauna			
Drakes Estero	<ul style="list-style-type: none"> Monitoring/managing invasive species Coastal Watershed Restoration: Geomorphic Restoration Project Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> Monitoring/managing invasive species CDFG MLPA initiative 	<ul style="list-style-type: none"> Monitoring/managing invasive species CDFG MLPA initiative
Wildlife and Wildlife Habitat: Fish			
Drakes Estero	<ul style="list-style-type: none"> Coastal Watershed Restoration: Geomorphic Restoration Project Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> CDFG MLPA initiative 	<ul style="list-style-type: none"> Restoration of the developed onshore area following SUP expiration CDFG MLPA initiative

TABLE 4-1. CUMULATIVE IMPACTS ANALYSIS (CONTINUED)

Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Wildlife and Wildlife Habitat: Harbor Seals			
Drakes Estero	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative
Wildlife and Wildlife Habitat: Birds			
Project area	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative 	<ul style="list-style-type: none"> ▪ Restoration of the developed onshore area following SUP expiration ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative
Special-status Species			
Drakes Estero	<ul style="list-style-type: none"> ▪ Kayaking ▪ Maintenance of red-legged frog ponds ▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Maintenance of red-legged frog ponds ▪ Planning and management activities ▪ CDFG MLPA initiative 	<ul style="list-style-type: none"> ▪ Restoration of the developed onshore area following SUP expiration ▪ Kayaking ▪ Maintenance of red-legged frog ponds ▪ Planning and management activities ▪ CDFG MLPA initiative
Coastal Flood Zones			
Project area			<ul style="list-style-type: none"> ▪ Restoration of the developed onshore area following SUP expiration ▪ Moving the vault toilet away from the shoreline

TABLE 4-1. CUMULATIVE IMPACTS ANALYSIS (CONTINUED)

Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Water Quality			
Drakes Estero	<ul style="list-style-type: none"> ▪ Fire management plan ▪ Ranching operations ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> ▪ Fire management plan ▪ Ranching operations 	<ul style="list-style-type: none"> ▪ Restoration of the developed onshore area following SUP expiration ▪ Fire management plan ▪ Moving the vault toilet away from the shoreline ▪ Ranching operations
Soundscapes			
Project area	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities 	<ul style="list-style-type: none"> ▪ Restoration of the developed onshore area following SUP expiration ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities
Wilderness			
Drakes Estero	<ul style="list-style-type: none"> ▪ Monitoring/managing invasive species ▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project 	<ul style="list-style-type: none"> ▪ Monitoring/managing invasive species ▪ Planning and management activities ▪ CDFG MLPA initiative 	<ul style="list-style-type: none"> ▪ Monitoring/managing invasive species ▪ Planning and management activities ▪ CDFG MLPA initiative
Visitor Experience and Recreation			
Project area	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities

TABLE 4-1. CUMULATIVE IMPACTS ANALYSIS (CONTINUED)

Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Socioeconomic Resources			
Marin County or, for the purposes of evaluating shellfish production, the State of California	<ul style="list-style-type: none"> ▪ Kayaking ▪ Ranching operations ▪ Economic trends 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Ranching operations ▪ Economic trends 	<ul style="list-style-type: none"> ▪ Kayaking ▪ Ranching operations ▪ California Aquaculture PEIR ▪ Expansion of mariculture within Humboldt Bay ▪ Change in NOAA Aquaculture Policy ▪ Economic trends
NPS Operations			
Seashore	<ul style="list-style-type: none"> ▪ Monitoring/managing invasive species ▪ Fire management plan ▪ Maintenance of red-legged frog ponds ▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project 	<ul style="list-style-type: none"> ▪ Monitoring/managing invasive species ▪ Fire management plan ▪ Maintenance of red-legged frog ponds ▪ Planning and management activities 	<ul style="list-style-type: none"> ▪ Restoration of the developed onshore area following SUP expiration ▪ Monitoring/managing invasive species ▪ Fire management plan ▪ Maintenance of red-legged frog ponds ▪ Moving the vault toilet away from the shoreline ▪ Planning and management activities

Cumulative Impact Contribution Terminology

In defining the contribution (i.e., incremental effect contributed) of each alternative to cumulative impacts, the following terminology is used.

- Imperceptible:** The incremental effect contributed by the alternative to the cumulative impact is so small that it is impossible or extremely difficult to detect.
- Noticeable:** The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the cumulative impact.
- Appreciable:** The incremental effect contributed by the alternative is evident and observable, and constitutes a large portion of the cumulative impact.

IMPACTS ON WETLANDS

LAWS AND POLICIES

Director's Order 77-1: Wetland Protection (NPS 2002a) sets the policy framework for the evaluation of NPS projects and their impacts on wetlands. This Director's Order is in direct response to President Carter's Executive Order 11990 issued in 1977, requiring federal agencies "to avoid to the extent possible the long- and short-term impacts associated with the destruction or modification of wetlands and to avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative." The aspect of avoidance established in DO-77-1 is consistent with the federal mandate of "no net loss" of wetlands, which was first adopted in 1989 (NPS 2002a). The term "no net loss" refers to the aquatic resource functions provided by wetlands (such as habitat, nutrient cycling, and biodiversity), not just acreage. In addition, *NPS Management Policies 2006* establishes a long-term goal of "net gain" in wetland habitat based on restoration of wetlands that have been degraded or lost due to past human activities (NPS 2006d).

All proposed work and/or structures extending into Drakes Estero from the line onshore reached by mean high tide designated as navigable waters of the United States, must be authorized by USACE pursuant to section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403). Additionally, all work and structures proposed in unfilled portions of the interior of diked areas below former mean high water (in this case, the pond behind the mobile homes) also must be authorized under section 10 of the same statute.

All proposed discharges of dredged or fill material into waters of the United States must be authorized by USACE pursuant to section 404 of the CWA (33 U.S.C. 1344). Waters of the United States generally include tidal waters, lakes, ponds, rivers, streams (including intermittent streams), and wetlands.

Lastly, USACE has established a nationwide permit for existing commercial shellfish aquaculture activities with no particular thresholds for the amount of structures related to aquaculture equipment that has been placed in waters or secondary impacts resulting from daily shellfish operations (Nationwide Permit 48 for *Existing Commercial Shellfish Aquaculture Activities*). If a shellfish operation does not qualify to be covered under this nationwide permit, an individual permit is required and will be subject to the CWA section 404 permit process.

METHODOLOGY

This section is focused on the impacts on intertidal wetlands (primarily mudflats) and their functions from the actions that would potentially occur under each alternative. Specific discussions for impacts on subtidal wetlands associated with vegetation (eelgrass) and fauna (benthic organisms, mammals, amphibians, invertebrates, fish, and birds) that use wetlands are discussed in the appropriate impact topic sections.

Intensity Definitions

Minor:	Impacts would be localized and slightly detectable, but would not affect the overall structure of any natural community.
Moderate:	Impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.
Major:	Impacts would be highly noticeable and would substantially influence natural resources, e.g., individuals or groups of species, communities, or natural processes.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including mariculture infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Under this alternative, removal of offshore infrastructure would allow natural wetland processes (vegetation and benthic organisms) to restore and resume. Specifically, removal of oyster culture bags from nonvegetated mudflats and sandbars in Drakes Estero would allow benthic organisms in Drakes Estero to recolonize the space previously occupied by the bags as has been shown in other studies (Dumbauld, Ruesink, and Rumrill 2009; Ruesink et al. 2005). Erosive forces on sediments caused by tidal water flowing across and around bags (NAS 2010) would be eliminated, restoring natural hydrodynamics to the 88 acres of sandbars and mudflats used by DBOC. Further, removal of the up to 142 acres of bags, racks, and other shellfish cultivation equipment from Drakes Estero would also reduce the potential for introduction of noxious species such as the exotic tunicate *Didemnum*, which has been shown to displace habitat for naturally occurring benthic organisms around the commercial shellfish operation infrastructure (Bullard, Lambert, et al. 2007).

Temporary local impacts on E2US wetlands (estuarine, intertidal, unconsolidated shore, sand/mud) may occur while DBOC facilities are being removed. Such impacts could include sediment disturbance of the Drakes Estero bottom during removal of the approximately 4,700 posts (2-inch by 6-inch boards) that support the shellfish racks and up to 88 acres of bottom bags. Sediment may also be disturbed by boat propellers in shallow areas, which would result in increased turbidity and temporary decreases in primary productivity due to decreased sunlight penetration in the water column (Newell 2004; Newell and Koch 2004). These impacts are expected to last for approximately one to two months.

Onshore operations would cease under alternative A, and DBOC equipment and personal property would be removed. During removal, soil disturbances are possible because exposed sediments are susceptible to erosive forces. This could cause long-term impacts from sediment transfer and suspended solids reaching neighboring wetlands. Such actions have the potential to directly deposit suspended solids in wetland

areas and smother wetland plants and organisms if not controlled. This could be mitigated by silt fencing as part of an erosion and sedimentation plan to contain any loose sediment until the site is stabilized.

Alternative A would eliminate the boats and barges associated with the commercial shellfish operation in Drakes Estero. This action would be expected to have beneficial impacts on wetlands within Drakes Estero due to the termination of propeller damage to E2US and E2AB wetlands (estuarine, intertidal, aquatic bed, rooted vascular) and the reduction in sediment disturbance to the intertidal mudflats and sandbars associated with propeller use in shallow waters. Beneficial impacts on wetlands would include a reduction in propeller-caused turbidity in the water column, which would result in increased sunlight penetration and therefore increased primary production.

Alternative A would remove the main dock extending into E2US wetlands. This action would provide for the restoration of a small portion of the Drakes Estero shoreline allowing sediment sorting and foraging/loafing areas for shorebirds.

As described above, alternative A would result in long-term beneficial impacts to wetlands because the removal of commercial shellfish infrastructure would allow natural processes to resume in areas where these structures displace natural wetland areas; impacts related to operations of motorboats would also cease. Alternative A would also result in short-term minor adverse impacts because removal of shellfish infrastructure would result in localized increases in sedimentation that would last less than two months.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wetlands within the project area. These actions include restoration of the onshore developed area following SUP expiration in 2012, coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and monitoring/managing invasive species.

Restoration of the developed onshore area following SUP expiration would restore natural wetlands that were filled decades ago. These restoration activities would result in long-term beneficial impacts on wetlands within the project area, affecting approximately 5 acres.

Efforts associated with recent coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) included the prevention of catastrophic failure of structures such as berms, dikes, and culverts through removal or stabilization and improvement efforts. These improvements would prevent future damage to downstream wetlands; therefore resulting in long-term beneficial impacts on wetlands within the project area.

Additionally, several invasive species known to occur at the Seashore grow in tidal marshes within Drakes Estero. If left unchecked, invasive species could overtake tidal wetland communities, resulting in a reduction in wetland functional quality and habitat for species that rely on vegetation diversity. Monitoring and managing the spread of invasive species is expected to provide long-term beneficial impacts on wetlands within the project area.

The impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial. The impacts of the past, present, and reasonably foreseeable future actions, when combined with the long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on wetlands within the project area. Alternative A would contribute an appreciable beneficial increment to the cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on wetlands within the project area. No wetlands would be permanently lost. The removal of personal property would increase the potential that the project area could be converted back to historic wetland habitat. Specifically, the removal of approximately 5 linear miles of racks and up to 88 acres of bags from nonvegetated sandbars and mudflats in Drakes Estero would allow benthic organisms in Drakes Estero to recolonize the space previously occupied by the bags. Additionally, erosive forces on sediments caused by tidal water flowing across and around bags would be eliminated, restoring natural hydrodynamics in up to 88 acres of sandbars and mudflats available for use by DBOC. Further, removal of the bags, racks, and other shellfish cultivation equipment from up to 142 acres of Drakes Estero would also reduce the potential for introduction and spread of invasive species such as the nonnative tunicate *Didemnum*. Reduction in propeller-caused turbidity in the water column also would result in increased sunlight penetration and therefore increased primary production. Removal of racks would result in short-term minor adverse impacts on wetlands because of a temporary increase in turbidity during removal of onshore structures, approximately 4,700 posts (2-inch by 6-inch boards) from the sediment within Drakes Estero, and up to 88 acres of bottom bags. This increase in turbidity would be highly localized and would last approximately one to two months. The cumulative impact would be long-term beneficial, and alternative A would contribute an appreciable beneficial increment to the cumulative impact.

With respect to wetlands, alternative A is consistent with relevant law and policy. The natural recovery of wetlands would be consistent with NPS *Management Policies 2006* and DO-77-1, which sets a goal of a “net gain” of wetlands (NPS 2006d, 2002a). USACE would be consulted to determine whether or not removal of commercial shellfish infrastructure would require permitting.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic
- Installation of a new dock, including dredging

Under alternative B, DBOC would have access to 84 acres of tidal mudflats and sandbars for bags and trays. For the past two years, approximately 22 acres per year have been planted. Under this alternative DBOC would continue to cultivate shellfish until 2022 at rates similar to current production and with the existing onshore infrastructure. Shellfish operations would require permitting at the state and federal level. Impacts on wetlands from the continuation of commercial shellfish operations for an additional 10 years under alternative B are described as follows.

Under this alternative, offshore infrastructure and operations would continue on approximately 138 acres of intertidal wetlands, resulting in long-term impacts on estuarine subtidal/intertidal aquatic bed/rooted vascular (E1/2AB3), estuarine intertidal unconsolidated shore-mud (E2US3), and estuarine intertidal unconsolidated shore-cobble-gravel-sand (E2US1/2) systems due to bottom bags, cluster culture for shell hardening and anchors for bag lines lying on the bottom substrate. While bottom bags are not permitted in eelgrass habitat, floating culture, including bags and seed trays are also present within the rack areas (DBOC [Lunny], pers. comm., 2011h).

Bottom bags containing Pacific oysters are turned approximately once every month; bags with Manila clams are not turned and may remain on tidal mudflats or sandbars for up to 18 months. As bags are manually placed, lifted, or turned over on the Drakes Estero bottom, sediment agitation, suspension, and transfer are expected to result in temporary impacts on intertidal wetlands. Impacts due to bag manipulation are directly related to the substrate disturbance. DBOC also places Pacific oyster cluster hanging culture in some beds to finish hardening their shell for a period of three months. No wetlands would be permanently lost. After bags or clusters are removed for oyster harvest or transfer, natural processes would be expected to resume in E2US3 and E2US1/2 wetlands until new culture is placed there. The length of time required for natural processes to resume would vary depending on the level of disturbance (Wisehart et al. 2007; Zieman 1976).

Alternative B includes the continued operation of boats and barges. DBOC staff use boats to access racks and bags for cultivation. Access to the floating/bottom bags and trays in the intertidal zones requires that boats navigate in shallow waters until they may be temporarily “beached” on the mudflat/sandbar bottom to allow personnel to access bags on foot during low tide. This action results in sediment disturbances and impacts on the estuarine intertidal sandbars and mudflats from footprints and boat hull scarring as well as propeller damage to subtidal and intertidal aquatic eelgrass beds (see “Impacts on Eelgrass”).

Alternative B would also include the continued existence of the onshore buildings and infrastructure. Minimal impacts on wetlands may occur from refuse and runoff entering the estuarine intertidal unconsolidated shore (E2US2), as well as the routine maintenance of docks, tanks, and the washing area. If not hauled to an offsite location, the accumulation of shell refuse material has the potential to encroach into the beach shoreline and cover habitat that would otherwise be available for intertidal wetland plant species.

Dredging of the E2US wetland in the vicinity of the boat dock would be conducted once to improve motorized boat access. This dredging would take place in an area approximately 30 feet by 60 feet to a depth of 3 feet. This would result in the removal of approximately 200 cubic yards of sediment in the intertidal area under the dock. Dredging activities would cause the temporary suspension of soil particles within the water column; however, suspended solids would be flushed from the work zone by daily tidal action. Because no vegetated wetlands would be permanently converted or lost, this action would be

considered a temporary impact on the E2US2 intertidal sand flat. DBOC would be required to obtain a permit authorization from USACE for the dredging activity.

As described above, alternative B would result in long-term moderate adverse impacts to wetlands within the project area because impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes for an additional 10 years. Alternative B would also result in short-term minor adverse impacts during dredging around the dock because it would result in a localized increase in sedimentation, lasting up to a week.

Upon expiration of the SUP in 2022, removal of commercial shellfish infrastructure and the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to wetlands in Drakes Estero. Impacts to wetlands associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wetlands within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and monitoring/managing invasive species as described under alternative A. Based on the information above, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative B, would result in a long-term moderate adverse cumulative impact. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on wetlands beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

During the life of the 10-year permit, impacts on wetlands under alternative B would be short-term minor adverse and long-term moderate adverse. Within the 138 acres of documented shellfish growing beds, actions associated with the placement of bottom bags on up to 84 acres of tidal mudflats/sandbars would continue under alternative B. Bottom bags have been placed in approximately 22 acres of mudflats and sandbars each of the past two years. Other impacts include pulse disturbances to mudflats and sandbars from the placement and rotation of bags/trays, DBOC staff walking across the mudflats/sandbars, and boat propellers and hulls scraping the bottom sediment. Onshore operations may cause a minor decrease in wetland functions and values from refuse and runoff along the shoreline if not collected and hauled offsite. No wetlands would be permanently converted to uplands under this alternative; however, impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes for an additional 10 years. Temporary impacts would be associated with dredging under

the new dock. Dredging would occur within a 30- by 60-foot area at the dock, resulting in a local short-term minor adverse impact on the silted bottom of Drakes Estero, with impacts expected to last one week due to a localized increase in sedimentation. The cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the cumulative impact.

By obtaining state and federal permits, alternative B would be consistent with relevant law and policy related to management of wetlands. DBOC's commercial shellfish operations and any dredge or fill activities within the waters of the United States (including Drakes Estero and the pond behind the mobile homes) are subject to permitting by USACE. Dredging the area around the dock would require USACE permit authorization. In a letter to NPS dated November 16, 2010, USACE stated:

“The aquaculture activities are within our jurisdiction and a permit is required. Review of our files indicates that the Drakes Bay Oyster Company aquaculture operation does not have a current permit application or permit on file. The Corps advises that the Drakes Bay Oyster Company submit a permit application to ensure their activities comply with our regulations. Application for Corps authorization should be made to this office.”
(USACE 2010)

The letter goes on to note that, if an individual permit is required, DBOC will need to “demonstrate to the Corps that any proposed fill is necessary because there are no practicable alternatives, as outlined in the U.S. Environmental Protection Agency's Section 404(b)(1) Guidelines” (USACE 2010).

Lastly, any future actions would be reviewed by NPS under DO-77-1; however, minor water-dependent actions (such as the installation of the new dock) are likely to be excepted from a statement of findings (per section 4.2.1 of NPS Procedural Manual 77-1; NPS 2002a).

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC's racks and bags would occupy the same space as under alternative B. Production would be limited to 500,000 pounds of shellfish per year, as compared to 600,000 pounds per year under alternative B. However, because the overall acreage of shellfish growing beds and racks would be the same and effort with respect to boat trips is likely to be similar to conditions described in B, the difference in production level is not expected to result in any difference in impacts to wetlands. Onshore operations and associated wetland impacts would be the same as those described under alternative B.

As described under alternative B, alternative C would result in long-term moderate adverse impacts to wetlands within the project area because impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes for an additional 10 years. Alternative

C would result in short-term minor adverse impacts during dredging around the dock because dredging would result in a localized increase in sedimentation, lasting up to a week.

Upon expiration of the SUP in 2022, removal of commercial shellfish infrastructure and the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to wetlands in Drakes Estero. Impacts to wetlands associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wetlands within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and monitoring/managing invasive species as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative C, would result in a long-term moderate adverse cumulative impact on wetlands. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC commercial shellfish operations in 2022 and the restoration of onshore facilities, cumulative impacts on wetlands beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

During the life of the 10-year permit, impacts on wetlands under alternative C would be short-term minor adverse and long-term moderate adverse. Actions associated with the placement of bottom bags on up to 84 acres of tidal mudflats/sandbars would continue under alternative C. Of the 138 acres available for use, bottom bags have been placed in approximately 22 acres of mudflats/sandbars each of the past two years and could be placed in up to 84 acres in Drakes Estero. Other impacts include pulse disturbances to mudflats/sandbars from the placement and rotation of bags/trays, DBOC staff walking across the mudflats/sandbars, and boat propellers and hulls scraping the bottom sediment. As under alternative B, onshore operations may cause a minor decrease in wetland functions and values from refuse and runoff along the shoreline if not collected and hauled offsite. No wetlands would be permanently converted to uplands under this alternative; however, impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes for an additional 10 years. Temporary impacts would be associated with dredging under the new dock within a 30- by 60-foot area at the dock, resulting in a local short-term minor adverse impact on the silted bottom of Drakes Estero, with impacts expected to last one week due to a localized increase in sedimentation. The cumulative impact would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

By obtaining relevant state and federal permits, alternative C would be consistent with relevant law and policy related to management of wetlands. DBOC's commercial shellfish operations and any dredge or fill activities within the waters of the United States (including Drakes Estero and the pond behind the mobile homes) are subject to permitting by USACE. Dredging the area around the dock would require USACE permit authorization. In a letter to NPS dated November 16, 2010, USACE stated:

“The aquaculture activities are within our jurisdiction and a permit is required. Review of our files indicates that the Drakes Bay Oyster Company aquaculture operation does not have a current permit application or permit on file. The Corps advises that the Drakes Bay Oyster Company submit a permit application to ensure their activities comply with our regulations. Application for Corps authorization should be made to this office.”
(USACE 2010)

The letter goes on to note that, if an individual permit is required, DBOC will need to “demonstrate to the Corps that any proposed fill is necessary because there are no practicable alternatives, as outlined in the U.S. Environmental Protection Agency's Section 404(b)(1) Guidelines” (USACE 2010).

Lastly, any future actions would be reviewed by the NPS under DO-77-1; however, minor water-dependent actions (such as the installation of the new dock) are likely to be excepted from a statement of findings (per section 4.2.1 of NPS Procedural Manual 77-1; NPS 2002a).

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact wetlands include:

- Production limit of 850,000 pounds of shellfish per year
- New onshore development
- Placement of a new intake pipeline

DBOC would have up to 84 acres of intertidal mudflats and sandbars available for bottom bag placement within Drakes Estero under this alternative. For the past two years, approximately 22 acres have been planted annually. Under this alternative, DBOC may increase shellfish production to 850,000 pounds per year (inclusive of all shellfish species). This level of production is approximately 40 percent greater than alternative B and 70 percent greater than alternative C. The increase in production may require additional bags/trays in the intertidal wetlands compared to alternatives B and C; however, this amount is undetermined. Thus, impacts on wetlands for offshore operations could be highest under this alternative. Any additional placement of bags on mudflats/sandbars would likely increase worker trips to manage the bagged shellfish compared to the other alternatives. Increased visits could cause additional boat and pedestrian impacts on the mudflats/sandbars from workers walking across the intertidal wetlands and from boat hulls and propellers scarring the Drakes Estero bottom.

Onshore operations and wetland impacts would be the same as those described under alternative B, with two additions. Alternative D would include the installation of a 1,050-foot intake structure and pipeline extending from the onshore facility into Drakes Estero to support the oyster processing operations. This would be considered a discharge of fill material in waters of the United States. While DBOC did not specify how the pipe would be anchored, it is expected to lie on the estuary bottom with minimal anchorage, impacting less than 0.1 acre of wetlands, and there would be no loss (i.e., permanent conversion to uplands) of wetlands. Alternative D would also call for the replacement of the existing processing plant with a larger facility to serve multiple functions, including housing new setting tanks. This action is expected to cause temporary exposure of local soils during construction and the potential risk of erosion and sediment transfer into intertidal wetlands of Drakes Estero until construction is completed and soils are either stabilized on site or removed. Mitigating actions preventing sediment transfer would include installing silt fencing/hay bales along the wetland/waters shoreline. Construction of the new building may have temporary minor adverse impacts on wetlands by increasing local turbidity levels and thus adversely affecting adjacent aquatic habitats for fish and shellfish. The building pad would avoid wetlands and is therefore not expected to cause adverse long-term impacts on wetlands.

As described above, alternative D would result in long-term moderate adverse impacts to wetlands within the project area because impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes for an additional 10 years. Alternative D would also result in short-term minor adverse impacts during dredging around the dock and placement of the new intake pipe because these actions would result in a localized increase in sedimentation, lasting up to a week.

As under the other action alternatives, upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to wetlands in Drakes Estero. Impacts on wetlands associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wetlands within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and monitoring/managing invasive species as described under alternative A. The impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative D, would result in a long-term moderate adverse cumulative impact. Alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on wetlands beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

During the life of the 10-year permit, impacts on wetlands under alternative D would be short-term minor adverse and long-term moderate adverse. Actions associated with the placement of bottom bags on up to 84 acres of tidal mudflats/sandbars would continue under alternative D. Of the 138 acres available for use, bottom bags have been placed in approximately 22 acres of mudflats/sandbars each of the past two years and could be placed in up to 84 acres in Drakes Estero. Other impacts include pulse disturbances to mudflats/sandbars from the placement and rotation of bags/trays, DBOC staff walking across the mudflats/sandbars, and boat propellers and hulls scraping the mud bottom. Because of the potential for higher production under this alternative (approximately 40 percent greater than alternative B and 70 percent greater than alternative C), the impacts associated with these actions would likely be greater than alternative B or C, but are still expected to be at a moderate level. As under alternatives B and C, onshore operations may cause a minor decrease in wetland functions and values from refuse and runoff along the shoreline if not collected and hauled offsite. No wetlands would be permanently converted to uplands under this alternative; however, impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes for an additional 10 years. Temporary impacts would be associated with dredging under the new dock (30- by 60-foot area), placement of a new 1,050-foot intake pipe along the bottom of Drakes Estero, and construction of a new processing facility. These actions are expected to result in short-term, minor adverse impacts due to an increase in local turbidity levels. The cumulative impact would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

By obtaining relevant state and federal permits, alternative D would be consistent with relevant law and policy related to management of wetlands. DBOC's commercial shellfish operations and any dredge or fill activities within the waters of the United States (including Drakes Estero and the pond behind the mobile homes) are subject to permitting by USACE. Installation of the intake pipe and dredging the area around the dock would require USACE permit authorization. In a letter to NPS dated November 16, 2010, USACE stated:

“The aquaculture activities are within our jurisdiction and a permit is required. Review of our files indicates that the Drakes Bay Oyster Company aquaculture operation does not have a current permit application or permit on file. The Corps advises that the Drakes Bay Oyster Company submit a permit application to ensure their activities comply with our regulations. Application for Corps authorization should be made to this office.”
(USACE 2010)

The letter goes on to note that, if an individual permit is required, DBOC will need to “demonstrate to the Corps that any proposed fill is necessary because there are no practicable alternatives, as outlined in the U.S. Environmental Protection Agency's Section 404(b)(1) Guidelines” (USACE 2010).

Lastly, any future actions would be reviewed by the NPS under DO-77-1; however, minor water-dependent actions (such as the installation of the new dock and placement of the water intake line) are likely to be excepted from a statement of findings (per section 4.2.1 of NPS Procedural Manual 77-1; NPS 2002a).

IMPACTS ON EELGRASS

LAWS AND POLICIES

NPS is responsible for protecting native species on NPS lands. Eelgrass is a native aquatic plant species of special ecological importance that occurs extensively in Drakes Estero. Eelgrass meadows (otherwise known as eelgrass beds) are classified as a special aquatic site, a category of waters of the United States afforded additional consideration under the CWA section 404(b)(1) guidelines developed by EPA. The guidelines are the environmental standards used by USACE to evaluate dredge and fill activities regulated under section 404 of the CWA. Under the 404(b)(1) guidelines, special aquatic sites are to be afforded greater protection than other waters of the United States because of their contribution to the overall environment. Special aquatic sites possess special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These sites are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. Eelgrass beds such as those found in Drakes Estero would be considered “vegetated shallows” as described in the regulations implementing this provision of the CWA (40 CFR 230 implementing section 404(b)(1) of the CWA). Activities regulated under the CWA are reviewed locally by USACE San Francisco District. In this regulatory district, there are specific conditions on general permits (also known as “nationwide permits”) that apply to eelgrass and eelgrass habitat, specifically regional conditions 3 and 4, which require notification of USACE for impacts on eelgrass beds and essential fish habitat.

Additionally, seagrasses (such as eelgrass beds in Drakes Estero) have been identified as essential fish habitat under the Groundfish Plan (PFMC 2008). Further, seagrasses are distinguished as habitat areas of particular concern, which is a subset of essential fish habitat that requires additional scrutiny during the consultation process under the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267).

In recognizing the importance of maintaining healthy populations of eelgrass for habitat and ecosystem functions, the Southern California eelgrass mitigation policy, which is a set of guidelines and requirements for eelgrass mitigation in the coastal zone of Southern California has been adopted (NOAA 2005). Similar guidelines for Northern California are currently in development, and those guidelines will draw from the Southern California model. For coastal projects requiring review by NMFS, USFWS, and/or CDFG, this policy provides the standardized interagency guidance on mitigating adverse impacts on eelgrass resources. For example, the mitigation policy has an exclusion clause for impacts less than 10 square meters, which can be used as a threshold in management decisions concerning eelgrass resources.

NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4) affords a high level of protection to maintain native species and natural processes. Directives include “preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them.” At the forefront of the NPS biological resource management philosophy is the goal of preserving the genetic stock of vegetation species naturally

occurring within park lands, as stated under section 4.4.1.2: “The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity” (NPS 2006d). DO-77-1 (NPS 2002a) sets the policy framework for the evaluation of NPS projects and their impacts on wetlands, including seagrasses. This Director’s Order requires NPS “to avoid to the extent possible the long- and short-term impacts associated with the destruction or modification of wetlands and to avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative.” In addition, *NPS Management Policies 2006* establishes a long-term goal of “net gain” in wetland habitat based on restoration of wetlands that have been degraded or lost due to past human activities (NPS 2006d).

METHODOLOGY

To assess the impact of propeller damage on eelgrass in Drakes Estero, recent high-resolution aerial photography was reviewed, and propeller damage lines were digitized using GIS technology. The source for the aerial photographs used in this analysis was CDFG imagery taken in 2010. The methodology used in this analysis draws from Zieman (1976), and more recently from NPS (2008a). In particular, propeller damage (also referred to as propeller “scarring”) of seagrasses is a common occurrence in shallow estuarine habitats, the effects of which can easily be observed as linear, dark signatures through seagrass beds on high-resolution aerial photography (Zieman 1976).

Interpretation of propeller scarring on the 2010 aerial photographs was limited to areas that were clearly identifiable as scars. Based on previous studies, this typically results in an underestimate of total scar length in shallow estuaries, because not all propeller scars will be visible from aerial photography (Zieman 1976; Sargent et al. 1995; NPS 2008a). Therefore, the total linear distance of eelgrass scarring in Drakes Estero based on this analysis is likely an underestimate. Due to the large variability among the widths of scars, this analysis method was not suited for calculating a comparable quantity for comparison with the 50-acre quantity reported by NAS (2009).

Intensity Definitions

Minor:	Impacts would be localized and slightly detectable, but would not affect the overall structure of any natural community. Impacts would not result in a measurable change to eelgrass ecosystem health on a local or regional scale.
Moderate:	Impacts would be clearly detectable and could appreciably affect individual plants, eelgrass beds, or natural processes (such as eelgrass colonization and/or regeneration). Impacts would result in measurable changes to eelgrass ecosystem health. Measurable changes could include modifications in biomass or in the diversity of species that typically use eelgrass beds for foraging or nursery grounds.
Major:	Impacts would be highly noticeable and would substantially influence natural resources, e.g., individuals or individual plants, eelgrass beds, or natural processes (such as eelgrass colonization and/or regeneration). Impacts would result in substantial changes to eelgrass ecosystem health, which would be evident through

large-scale changes in ecological indicators such as biomass or in the diversity of species that typically use eelgrass beds for foraging or nursery grounds.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

In summarizing the effects of oyster mariculture on eelgrass in Drakes Estero, the NAS concluded:

“Limited observations of eelgrass in Drakes Estero demonstrate absence of eelgrass directly under oyster culture racks and from propeller scar damage attributable to boats operated by the oyster farm. Mariculture activities had an impact on about 8% of the eelgrass habitat in Drakes Estero in 2007: 1% of eelgrass acreage was displaced by oyster racks and 7% was partially scarred by boat transit through the eelgrass beds. Research elsewhere demonstrates that damaged eelgrass blades have rapid regeneration capacity and that eelgrass productivity can be locally enhanced by the cultured oysters through a reduction in turbidity and fertilization via nutrient regeneration. Eelgrass habitat within Drakes Estero has doubled from 1991 to 2007 a trend seen in some other west coast estuaries.” (NAS 2009)

Under alternative A, the termination of DBOC activities in Drakes Estero would remove the actions associated with shellfish mariculture that result in direct, documented damage to eelgrass habitat, such as propeller scarring, boat wake erosion, and temporary increases in turbidity from sediment resuspension (see discussion under alternative B). This would result in beneficial impacts on eelgrass due to the following: (1) eelgrass would no longer be subject to physical damage by DBOC boat propellers and, as such, would be expected to recolonize areas that have been disturbed by boat propellers (Waddell 1964, as cited in Simenstad and Fresh 1995; Zieman 1976); (2) eelgrass would no longer be subject to erosion created by DBOC-boat-generated waves, which have been shown to cause erosion of eelgrass along the edges of navigation channels (Thom et al. 2003); and (3) eelgrass would no longer be subject to the temporary increases in turbidity caused by boat propellers disturbing and resuspending bottom sediments (Koch 2001, 2002). Each of these conditions would likely result in increases in density, biomass, and primary productivity of eelgrass due to the cessation of DBOC boat traffic in Drakes Estero.

NAS (2009) discussed an increase in eelgrass between 1991 and 2007. The conclusion from the NAS report was that eelgrass was expanding despite the ongoing commercial shellfish operations but notes this trend was not only observed in Drakes Estero. The NAS report did not evaluate the potential reasons that could be attributed to the expansion.

The termination of DBOC activities and removal of approximately 4,700 posts (2-inch by 6-inch boards) that support the shellfish racks would greatly reduce the potential for shellfish mariculture-related

introductions of nonnative species such as colonial tunicates, which take advantage of the hard substrate created by the mariculture structures, and have recently been documented colonizing the leaf blades of eelgrass (Carman et al. 2009; Carman and Grunden 2010; Grosholz 2011b; see discussion under alternative B). Removal of DBOC activities would also reduce the potential for offshore mariculture structures such as racks and bags to stimulate the growth of algae, which can become established on nearby eelgrass blades (termed “epiphytic” algae) (Hauxwell et al. 2001; Dumbauld, Ruesink, and Rumrill 2009; NAS 2010; see discussion under alternative B). When eelgrass blades become covered with species such as invasive tunicates or epiphytic algae, this reduces the surface area of the leaves that are exposed to sunlight for photosynthesis. Therefore, because alternative A would reduce the potential for such leaf-blade colonization, the result would be long-term beneficial impacts on eelgrass due to the associated increases in primary productivity.

As described under alternative B, DBOC offshore infrastructure, including oyster racks and some bags, reduce coverage and density of eelgrass due to shading or preemption of space (NAS 2009). Under alternative A, all shellfish cultivation equipment within the 138 acres of growing areas would be removed, including the 5 linear miles (7 acres) of shellfish racks and up to 88 acres of bottom bags. Removal would allow eelgrass to recolonize substrates previously beneath the bags and racks (NAS 2009), resulting in short- and long-term beneficial impacts on eelgrass. Recovery of eelgrass would provide additional natural habitat for the fish communities within Drakes Estero. This secondary benefit to the natural community is discussed in greater detail under “Impacts on Wildlife and Wildlife Habitat: Fish.”

NAS (2009) suggests that eelgrass productivity can be locally enhanced by bivalves. Based on west coast research (Dumbauld, Ruesink, and Rumrill 2009), the positive ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would be expected to be relatively minor in west coast estuaries like Drakes Estero. This is because the nutrient dynamics in these systems are driven by coastal upwelling and a strong tidal cycle which flushes small estuaries like Drakes Estero on a daily basis. However, to the extent that localized beneficial effects from DBOC bivalves influence eelgrass productivity near DBOC beds and racks (see discussion under alternative B), the removal of DBOC-cultured bivalves under alternative A would result in adverse impacts on eelgrass at these sites.

Removal of approximately 4,700 posts (2-inch by 6-inch boards) that support the approximately 5 linear miles (or 7 acres) of shellfish racks in Drakes Estero would alleviate the potential for erosion associated with those structures, allowing the substrate to stabilize at these sites (Harbin-Ireland 2004¹¹; Everett, Ruiz, and Carlton 1995). Although the removal itself could be expected to cause temporary increases in sedimentation (lasting one to two months), removal would ultimately result in a beneficial impact on eelgrass, which would be expected to recolonize the stabilized substrate underneath the racks once the racks are removed.

As described above, alternative A would result in long-term beneficial impacts on eelgrass due to the termination of DBOC operations within Drakes Estero, as well as the removal of structures that currently inhibit eelgrass abundance and serve as potential points of introduction and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic algae, which is already occurring in proximity to DBOC structures within Drakes Estero. Alternative A also would result in short-term minor adverse impacts because removal of mariculture infrastructure would result in localized increases in sedimentation that would last less than two months.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact eelgrass within the project area. These actions include monitoring/managing invasive species, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative.

Monitoring and management of invasive species efforts also could benefit eelgrass within the project area. In particular, invasive tunicates (*Didemnum* spp.) have recently been found to colonize eelgrass blades. While the nonnative eelgrass *Zostera japonica* is found elsewhere in California, introduction remains an ongoing risk. The management of these invasive species that are detrimental to eelgrass growth and persistence would result in long-term beneficial impacts on eelgrass in the project area.

Planning and management activities may enable management activities such as administrative and research motorboat use within Drakes Estero. This would cause impacts on eelgrass similar to those discussed above caused by DBOC motorboats; however, boat use within Drakes Estero is subject to minimum requirement and minimum tool analysis under the Wilderness Act, would be highly infrequent, and timing and location of access could be limited. Therefore, the adverse impacts from these activities would be less than minor.

Coastal watershed restoration projects recently completed by the Seashore, including the Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project, could improve water quality within Drakes Estero, providing indirect long-term beneficial impacts on eelgrass within the project area. Additionally, because eelgrass is a resource targeted for protection under the MLPA, this designation would result in long-term beneficial impacts on eelgrass.

Based on the information above, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on eelgrass. Alternative A would contribute an appreciable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on eelgrass habitat due to the termination of DBOC operations within Drakes Estero, as well as the removal of structures that currently inhibit eelgrass abundance and serve as potential points of introduction and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic algae. There may be some highly localized adverse impacts on eelgrass associated with removal of the commercially grown shellfish because they provide some benefits associated with nutrient cycling and water filtration; however, the overall long-term impacts of alternative A on eelgrass would be beneficial. Alternative A also would result in short-term minor adverse impacts because removal of mariculture infrastructure would result in localized increases in sedimentation that would last less than two months. The cumulative impact would be long-term beneficial, and alternative A would contribute an appreciable beneficial increment to the overall cumulative impact.

With respect to eelgrass, alternative A is consistent with relevant law and policy because it would preserve and enhance (1) a special aquatic site, a category of waters of the United States afforded additional consideration under the CWA, (2) essential fish habitat (habitat of particular concern) under the Groundfish Plan, and (3) native species and natural processes encouraged by *NPS Management Policies 2006*.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact eelgrass include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

As described in chapter 3, extensive beds of eelgrass are present throughout Drakes Estero (Wechsler 2004ⁱⁱⁱ; NAS 2009). DBOC activities, particularly boat traffic, adversely impact eelgrass biomass and abundance because plants are uprooted or otherwise physically damaged by boat propellers (NAS 2009). Propeller damage (also referred to as propeller scarring) of seagrasses is a common occurrence in shallow estuarine habitats. Recovery time for seagrasses is influenced by factors such as the physical conditions at the site and the amount of damage. Once a propeller scar is created, wave action or fast-moving currents can lead to erosion within the scar, resulting in scouring and deepening of the disturbed area. Heavily scarred beds may also be prone to further damage or destruction by severe storms (Fonseca and Bell 1998). In addition, reduction in water clarity through resuspension of sediments destabilized by seagrass removal can lead to more extensive declines in cover (Preen, Lee Long, and Coles 1995).

The effects of propeller scars can easily be observed as linear, dark lines through seagrass beds on high-resolution aerial photography (Zieman 1976). In their review of shellfish mariculture impacts on eelgrass in Drakes Estero, the NAS (2009) cites an estimated 50 acres of eelgrass habitat that was impacted by propeller damage based on review of 2007 aerial photography, but qualifies the estimate by noting that it was “loosely quantified” due to the resolution of the imagery used. This 50-acre quantity was based on an area drawn around all sections of Drakes Estero with propeller scars. In an effort to provide a more detailed and current assessment of propeller damage to eelgrass, recent (2010) high-resolution aerial photography of Drakes Estero was evaluated using GIS technology. This evaluation showed that 8.5 miles (45,031 linear feet) of propeller scars through eelgrass could readily be seen on the aerial images. The width of propeller scars in Drakes Estero is highly variable and can range from one to several feet wide. Interpretation of propeller scarring on the 2010 aerial photographs was limited to areas that were clearly identifiable as scars using techniques developed by Zieman (1976); therefore, the 8.5-mile total is likely an underestimate. Scarring observed in algae was not included in the analysis.

Because of NPS prohibitions on motorized vessels pursuant to the Point Reyes Wilderness Act of 1976, motorized boats used in DBOC’s commercial shellfish operations represent the primary contributing factor to propeller scarring in Drakes Estero (NAS 2009). Although the existing SUP requires DBOC to submit a boating operations plan that would designate primary navigation routes designed to minimize

impacts on eelgrass, DBOC has not submitted this plan. Propeller scars visible on the 2010 high-resolution aerial photographs show that DBOC vessels transit through eelgrass, resulting in readily observable propeller damage.

In addition, DBOC operations adversely impact eelgrass cover and density because boats disturb the bottom substrate (Anima 1991^{iv}), thereby adversely affecting the rooting medium for eelgrass. Eelgrass regrowth into propeller scar areas can be relatively rapid (weeks), or it can take as long as 2 to 5 years, depending on the severity of the impact on the substrate or the root systems (Waddell 1964, as cited in Simenstad and Fresh 1995; Zieman 1976). Further, “propeller wash” (i.e., water turbulence behind propellers in boat wakes) and boat-generated waves are known to erode eelgrass along the edges of navigation channels, a phenomenon that has been documented both on the west coast (Thom et al. 2003) and on the east coast (Peterson, Summerson, and Fegley 1987; Koch 2002). Finally, boat traffic can cause a reduction in photosynthesis, and therefore biomass, due to the following: (1) boat traffic causes temporary increases in water column turbidity due to resuspension of sediments, (2) increased turbidity reduces the depth to which sunlight can penetrate the water column, (3) sunlight is a requirement for photosynthesis, and (4) plants must photosynthesize to add biomass; therefore, (5) boat-induced turbidity results in temporary reductions in photosynthesis and can stall or reverse biomass accumulation (Koch 2001, 2002). It is anticipated that regardless of the regrowth and recovery rates of eelgrass in the Estero, the amount of scarring under alternative B would remain similar to that observed in the 2010 aerial photographs.

Based on research conducted in Drakes Estero, bags and racks used for shellfish cultivation have been shown to reduce coverage and density of eelgrass due to shading or preemption of space (e.g., Wechsler 2004^v; NAS 2009). Similar results have been found underneath structures used for oyster cultivation in other California estuaries, e.g., Humboldt Bay (Rumrill and Poulton 2004), and throughout the west coast (Pregnall 1993; Simenstad and Fresh 1995; Ruesink et al. 2005; Everett, Ruiz, and Carlton 1995; Tallis et al. 2009). Reduced coverage and density of eelgrass under or adjacent to racks and bags have an associated reduction in primary productivity of eelgrass, because there is less leaf area available to photosynthesize (Everett, Ruiz, and Carlton 1995; Rumrill and Poulton 2004; Tallis et al. 2009; NAS 2010). In addition, lower eelgrass abundance results in a reduction of habitat for wildlife species that use eelgrass for nursery grounds, refuge, and food (Simenstad and Fresh 1995; Dumbauld, Ruesink, and Rumrill 2009; NAS 2009). See “Wildlife and Wildlife Habitat: Fish” for additional detail on how this affects fish species within Drakes Estero.

As noted in NAS (2009), commercial shellfish operations have caused the expansion of nonnative invasive species such as the invasive tunicate *Didemnum* into various habitats in Drakes Estero. Although hard structures such as oyster racks and bags represent a point of introduction and/or expansion for this species (Bullard, Lambert, et al. 2007), recent research has shown that this species has the capacity to colonize soft substrates such as eelgrass blades (Carman et al. 2009; Carman and Grunden 2010; NAS 2010). Invasive tunicates have been recently observed colonizing eelgrass blades in Drakes Estero (Grosholz 2011b). Tunicates on eelgrass blades reduce the portions of the blades exposed to sunlight for photosynthesis; therefore, in areas where *Didemnum* can colonize eelgrass blades, there would be a reduction in primary productivity and biomass of eelgrass. Tunicates also render eelgrass blades inedible to foraging species such as the black brant.

In addition, bivalve cultivation has been shown to stimulate the growth of algae, which can cover the surfaces of structures such as racks and bags. When this type of growth occurs adjacent to eelgrass, the

algae (termed “epiphytic” algae) can become established on the eelgrass blades and thereby reduce the photosynthetic surface of the eelgrass blades, which can lead to a reduction in primary productivity as noted above (Hauxwell et al. 2001; Dumbauld, Ruesink, and Rumrill 2009; NAS 2010).

Shellfish mariculture can also have beneficial impacts on eelgrass due to the beneficial effects normally attributed to filter-feeding bivalves in estuaries (Newell and Koch 2004). Studies of bivalve mariculture in estuarine systems worldwide have noted that filter feeders such as oysters and clams remove suspended particles from the water column during feeding, which has the potential to reduce turbidity and increase light penetration, a benefit for photosynthetic organisms such as eelgrass (Peterson and Heck 1999, 2001; NAS 2010). Deeper light penetration through the water column has the potential to expand the range over which submerged aquatic vegetation can live on the bottom substrate. Further, researchers have noted the potential for increased fertilization from “biodeposits,” or the byproducts of bivalve feeding, which would potentially stimulate growth of seagrasses and increase biomass and abundance (Newell and Koch 2004; NAS 2010). However, it should be noted that most of the studies showing the beneficial effects of bivalve cultivation (such as water clarity and sediment nutrient enrichment) were conducted in estuaries with relatively turbid waters full of particulates, with low to moderate tidal flushing. By contrast, Drakes Estero is not a highly turbid coastal embayment (NAS 2009), so bivalve contributions to water clarity would likely be relatively minor. Further, west coast estuaries are exposed to a relatively large tidal cycle in which they are flushed with nutrient-rich water from ocean-derived coastal upwelling, a phenomenon that controls summer nutrient cycles and productivity in coastal systems like Drakes Estero (Largier, Hollibaugh, and Smith 1997; NAS 2009). Clarity and productivity characteristics are also due in part to the relatively small watersheds that feed into coastal lagoon systems like Drakes Estero, because small watersheds do not tend to contribute large volumes of suspended sediments and organic detritus. Under such conditions, bivalve contributions to nutrient replenishment would be relatively small, perhaps only locally detectable under or immediately adjacent to commercial shellfish beds or structures (Dumbauld, Ruesink, and Rumrill 2009; NAS 2010).

Finally, under alternative B, DBOC would maintain up to 5 linear miles (7 acres) of racks within Drakes Estero. Oyster racks have been shown to cause changes in sediment/substrate quality due to erosion and/or sedimentation processes that are increased by the presence of the structures (NAS 2010). Erosion in particular has been noted in association with oyster racks in Drakes Estero (Harbin-Ireland 2004vi) and in Coos Bay, Oregon (Everett, Ruiz, and Carlton 1995). Erosion reduces substrate quality and availability for colonization by eelgrass, thus contributing to the reduction in eelgrass abundance and cover beneath the racks.

As described above, alternative B would result in long-term moderate adverse impacts on eelgrass in Drakes Estero for another 10 years. Impacts would be clearly detectable and could appreciably affect individual plants, eelgrass beds, and natural processes (such as eelgrass colonization and/or regeneration).

Upon expiration of the SUP in 2022, the removal of racks and bags from Drakes Estero and conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes to impacts on eelgrass in Drakes Estero. Particularly, the cessation of commercial shellfish operations in Drakes Estero would remove structures that currently inhibit eelgrass abundance and serve as potential points of introduction and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic algae. In addition, propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), boat wake erosion, and temporary increases in turbidity from sediment resuspension would

cease. Prolonging the presence of nonnative species under alternative B could hinder NPS efforts at invasive species management in Drakes Estero and could lengthen the period of time before a natural eelgrass community could be re-established, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the shellfish operation.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact eelgrass within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include monitoring/managing invasive species, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, these past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts on eelgrass. The beneficial impacts of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative B, would result in a long-term moderate adverse cumulative impact on eelgrass. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

Conclusion

Overall, alternative B would result in long-term moderate adverse impacts on eelgrass in Drakes Estero due to the operation of DBOC boats for another 10 years and the continued presence of commercial shellfish infrastructure within Drakes Estero. DBOC activities in Drakes Estero under alternative B would allow the continuation of actions associated with commercial shellfish operations that could damage eelgrass habitat, such as propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), boat wake erosion, and temporary increases in turbidity from sediment resuspension given the area of boat operations within Drakes Estero. It is anticipated that the amount of scarring under alternative B would remain similar to that observed in the 2010 aerial photographs. Further, the continuation of DBOC activities would increase the potential for shellfish mariculture-related introductions of nonnative species (e.g., colonial tunicates) and epiphytic algae, which would have a long-term adverse impact on eelgrass. Maintenance of offshore infrastructure would continue to preclude eelgrass colonization underneath the beds and approximately 7 acres of racks. Beneficial ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would continue, but these beneficial impacts would be expected to be relatively small in a west coast estuary like Drakes Estero due to high sediment-nutrient content, extensive tidal flushing, and proximity to nutrient-rich upwelling zones along the Pacific coast. Finally, maintenance of oyster racks within Drakes Estero would prolong the erosional condition that is occurring under the racks. In general, impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes. The NAS concluded that mariculture in Drakes Estero results in impacts on eelgrass from the presence of racks and from boat propeller scars, but these impacts are somewhat offset by the “rapid regeneration capacity” for eelgrass and “that eelgrass productivity can be locally enhanced by the cultured oysters through a reduction in turbidity and fertilization via nutrient regeneration” (NAS 2009). Although there are some highly localized beneficial impacts on eelgrass associated with commercial shellfish operations, the overall impact of alternative B

on eelgrass would be moderate and adverse. The cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to eelgrass, alternative B does not further the goals set forth in existing law and policy because it would allow ongoing adverse impacts on (1) a special aquatic site, a category of waters of the United States afforded additional consideration under the CWA, (2) essential fish habitat (habitat of particular concern) under the Groundfish Plan, and (3) native species and natural processes (including native species management) under NPS *Management Policies 2006*.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact eelgrass are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC's racks and bags would occupy the same space as under alternative B. Production would be limited to 500,000 pounds of shellfish per year, as compared to 600,000 pounds per year under alternative B. However, because the overall acreage of shellfish growing beds and racks are the same and effort with respect to boat trips is likely similar to conditions described in alternative B, the difference in production levels is not expected to result in any difference in impacts to eelgrass. Therefore, the impacts of alternative C on eelgrass are the same as those of alternative B.

As described above, alternative C would result in long-term moderate adverse impacts on eelgrass in Drakes Estero for another 10 years. Impacts would be clearly detectable and could appreciably affect individual plants, eelgrass beds, and natural processes (such as eelgrass colonization and/or regeneration).

Upon expiration of the SUP in 2022, the removal of racks and bags from Drakes Estero and conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes to impacts on eelgrass in Drakes Estero. Particularly, the cessation of shellfish operations in Drakes Estero would remove structures that currently inhibit eelgrass abundance and serve as potential points of introduction and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic algae. In addition, propeller scarring (estimated 8.5 miles based on 2010 aerial photography), boat wake erosion, and temporary increases in turbidity from sediment resuspension would cease. Prolonging the presence of nonnative species under alternative C could hinder NPS efforts at invasive species management in Drakes Estero and could lengthen the period of time before a natural eelgrass community could be re-established, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the commercial shellfish operation.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact eelgrass within the project area. Actions that have the potential to combine with the impacts of Alternative C during the 10-

year period of the new SUP include monitoring and management of invasive species, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, these past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts on eelgrass. The beneficial impacts of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative C, would result in a long-term moderate adverse cumulative impact on eelgrass. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative C would result in long-term moderate adverse impacts on eelgrass in Drakes Estero due to the operation of DBOC boats for an additional 10 years and the continued presence of shellfish infrastructure within Drakes Estero. DBOC activities in Drakes Estero under alternative C would allow the continuation of actions associated with commercial shellfish operations that could damage eelgrass habitat, such as propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), boat wake erosion, and temporary increases in turbidity from sediment resuspension given the area of boat operations within Drakes Estero. It is anticipated that because the level of boat use would remain similar, the amount of scarring under alternative C would remain similar to that observed in the 2010 aerial photographs. Further, the continuation of DBOC activities would increase the potential for shellfish mariculture-related introductions of nonnative species (e.g., colonial tunicates) and epiphytic algae. Maintenance of offshore infrastructure would continue to preclude eelgrass colonization underneath the beds and approximately 7 acres of racks. Beneficial ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would continue, but these beneficial impacts would be expected to be relatively small in a west coast estuary like Drakes Estero due to high sediment-nutrient content, extensive tidal flushing, and proximity to nutrient-rich upwelling zones along the Pacific coast. Finally, maintenance of oyster racks within Drakes Estero would prolong the erosional condition that is occurring under the racks. In general, impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes. The NAS concluded that mariculture in Drakes Estero results in impacts on eelgrass from the presence of racks and from boat propeller scars, but these impacts are somewhat offset by the “rapid regeneration capacity” for eelgrass and “that eelgrass productivity can be locally enhanced by the cultured oysters through a reduction in turbidity and fertilization via nutrient regeneration” (NAS 2009). Although there are some highly localized beneficial impacts on eelgrass associated with shellfish operations, the impact of alternative C on eelgrass would be moderate and adverse. The cumulative impact would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

With respect to eelgrass, alternative C does not further the goals set forth in existing law and policy because it would allow ongoing adverse impacts on (1) a special aquatic site, a category of waters of the United States afforded additional consideration under the CWA, (2) essential fish habitat (habitat of particular concern) under the Groundfish Plan, and (3) native species and natural processes (including native species management) under NPS *Management Policies 2006*.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact eelgrass are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact eelgrass include:

- Production limit of 850,000 pounds of shellfish per year

Under alternative D, DBOC could produce up to 850,000 pounds of shellfish meat annually. Impacts on eelgrass associated with alternative D would be expected to be greater than those associated with alternatives B and C, due to the likely increase in boat traffic and area of vessel operations needed to harvest the proposed 850,000 pounds of shellfish meat annually.

As described above, alternative D would result in long-term moderate adverse impacts on eelgrass in Drakes Estero. These adverse impacts would be of greater magnitude than those associated with alternatives B and C due to the likely increase in boat traffic in Drakes Estero, and the increased use of bags and racks in shellfish operations for another 10 years. Impacts would be clearly detectable and could appreciably affect individual plants, eelgrass beds, and natural processes (such as eelgrass colonization and/or regeneration).

Upon expiration of the SUP in 2022, the removal of racks and bags from Drakes Estero and conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes to impacts on eelgrass in Drakes Estero. Particularly, the cessation of commercial shellfish operations in Drakes Estero would remove structures that currently inhibit eelgrass abundance and serve as potential points of introduction and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic algae. In addition, propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), boat wake erosion, and temporary increases in turbidity from sediment resuspension would cease. Prolonging the presence of nonnative species under alternative D could hinder NPS efforts at invasive species management in Drakes Estero and could lengthen the period of time before a natural eelgrass community could be re-established, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the commercial shellfish operation.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact eelgrass within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include monitoring/managing invasive species, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, these past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts on eelgrass. The beneficial impacts of these past, present, and reasonably foreseeable future actions, when combined with

the long-term moderate adverse impacts of alternative D, would result in a long-term moderate adverse cumulative impact on eelgrass. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative D would result in long-term moderate adverse impacts on eelgrass in Drakes Estero due to an additional 10 years of DBOC operations. DBOC activities in Drakes Estero under alternative D would allow the continuation of and potential increase in actions associated with commercial shellfish mariculture that result in damage to eelgrass habitat, such as propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), boat wake erosion, and temporary increases in turbidity from sediment resuspension. It is anticipated that due to the likely increase in boat traffic and area of vessel operations that the potential for scarring may be increased from the levels observed in the 2010 aerial photography. Further, the continuation of DBOC activities would increase the potential for shellfish mariculture-related introductions of nonnative species (e.g., colonial tunicates) and epiphytic algae. Maintenance of offshore infrastructure would continue to preclude eelgrass colonization underneath the beds and racks. Beneficial ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would continue, but these beneficial impacts would be expected to be relatively minor in a west coast estuary like Drakes Estero (i.e., with high sediment-nutrient content, extensive tidal flushing, and proximity to nutrient-rich upwelling zones along the Pacific coast). Finally, maintenance of oyster racks within Drakes Estero would prolong the erosional condition that is occurring under the racks. These adverse impacts would be of greater magnitude than those associated with alternatives B and C due to the likely increase in boat traffic in Drakes Estero associated with the increased level of production (approximately 40 percent greater than alternative B and 70 percent greater than alternative C), and the increased use of bags and racks in shellfish operations, but are still expected to be of a moderate intensity. Impacts would be clearly detectable and could appreciably affect individual plants, eelgrass meadows, and natural processes (such as eelgrass colonization and/or regeneration). The cumulative impact would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to eelgrass, alternative D does not further the goals set forth in existing law and policy because it would allow ongoing adverse impacts on (1) a special aquatic site, a category of waters of the United States afforded additional consideration under the CWA, (2) essential fish habitat (habitat of particular concern) under the Groundfish Plan, and (3) native species and natural processes (including native species management) under NPS *Management Policies 2006*.

IMPACTS ON WILDLIFE AND WILDLIFE HABITAT: BENTHIC FAUNA

LAWS AND POLICIES

NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4 et seq.) states that “the National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems.” Directives for maintaining native species include “preserving and

restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them.” At the forefront of the NPS biological resource management philosophy is the goal of preserving the genetic stock of wildlife species naturally occurring within park lands, as stated under section 4.4.1.2: “The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity” (NPS 2006d). Privately owned organisms such as cultured shellfish are not part of natural communities and ecosystems under NPS *Management Policies 2006*. Also, in accordance with 36 CFR 2.1 et seq., activities involving “possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state” biological resources is prohibited on park lands except where explicitly allowed by a park superintendent.

One of the population management objectives specified in section 4.4.1.1 states that the NPS will “prevent the introduction of exotic species into units of the national park system, and remove, when possible, or otherwise contain individuals or populations of these species that have already become established in parks” (NPS 2006d). Exotic species are defined as those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Exotic species are also commonly referred to as nonnative, alien, or invasive species.

Section 4.4.4 of NPS *Management Policies 2006* dictates the management of nonnative species. This section states that, in general, “new exotic species will not be introduced into parks. In rare situations, an exotic species may be introduced or maintained to meet specific, identified management needs” (NPS 2006d). NPS *Management Policies 2006* places a high value on and apply a high standard of protection to native species and natural processes in NPS units. Threats to these resources, such as invasive aquatic species, are aggressively managed, and the use of nonnative species as a management tool is an acceptable option only when “all feasible and prudent measures to minimize the risk of harm have been taken” and at least one of a number of criteria listed in section 4.4.4.1 have been met. Otherwise, *Management Policies 2006* states that all nonnative species that are not maintained to meet a park purpose will “be managed—up to and including eradication—if (1) control is prudent and reasonable,” and (2) the nonnative species “interferes with natural processes and the perpetuation of natural features, native species or natural habitats,” or meets any of the other criteria listed in this section (NPS 2006d).

METHODOLOGY

This section summarizes the impacts on benthic fauna from those actions that could potentially occur under each alternative. In consideration of the different types of benthic organisms within the project area discussed in chapter 3, impacts are evaluated in the context of the type of impact (direct, indirect), the nature of the impact (i.e., type of disturbance to benthic fauna), the quality and amount of benthic fauna habitat impacted, and the potential for risks posed by proposed actions (e.g., introduction of nonnative species).

Intensity Definitions

Minor:	Impacts would be localized and slightly detectable, but would not affect the overall structure of any natural community.
Moderate:	Impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.
Major:	Impacts would be highly noticeable and would substantially influence natural resources, e.g., individuals or groups of species, communities, or natural processes.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Under alternative A, the termination of DBOC activities in Drakes Estero would remove actions associated with shellfish mariculture that could otherwise cause the introduction of nonnative species, such as bivalves and/or molluscan diseases (see discussion under alternative B). This would have a long-term beneficial impact on native bivalves and local diversity of native benthic fauna because it would remove the potential for commercially grown nonnative bivalves to escape cultivation, become established in Drakes Estero, and outcompete native benthic species (NAS 2010). The native invertebrates of Drakes Estero are species typically adapted to soft-bottom and eelgrass habitats common throughout the middle and upper reaches of Drakes Estero, where the commercial shellfish operations facilities are located (see “Benthic Fauna” discussion, chapter 3). Removal of shellfish mariculture (including 7 acres of racks and up to 88 acres of bottom bags) from Drakes Estero would also reduce the potential for introduction of bivalve diseases, which can be borne by cultured shellfish (Friedman 1996; Bureson and Ford 2004). In addition, Manila clams have recently been documented growing outside of cultivation areas (naturalizing) in Drakes Estero (Grosholz 2011b), and the removal of this nonnative cultured species would eliminate the risk of continued naturalization.

After years of shellfish production in Drakes Estero, the invasive tunicate *Didemnum* has become established in Drakes Estero. The removal of offshore commercial shellfish infrastructure would minimize the potential for new colonization of invasive tunicates, which the NAS report associated with DBOC’s mariculture structures (NAS 2009) (see discussion under alternative B). Invasive colonial tunicates have the potential to smother habitats and inhibit normal biological functions of benthic fauna (Osman and Whitlatch 2007; Mercer, Whitlatch, and Osman 2009). In addition, shellfish mariculture structures can support a variety of other fouling nonnative and native organisms (which attach to underwater structures during their adult phase, inhibiting the normal function of the structure). Examples of other fouling organisms include barnacles, sponges, and goblet worms (Light, Grosholz, and Moyle

2005). Removal of these structures would reduce the available substrate over which harmful fouling organisms could attach and grow. Finally, the ability of invasive tunicates (such as *Didemnum*) to regenerate after being fragmented increases their dispersal capabilities (Bullard, Sedlack, et al. 2007), which can be worsened by activities associated with the maintenance of oyster bags and racks (NAS 2009). Therefore, the termination of commercial shellfish activities would reduce the risk of further dispersing the tunicate. Reduction in overall cover of invasive tunicates would have a long-term beneficial effect on native benthic fauna diversity.

Studies in Drakes Estero (Harbin-Ireland 2004^{vii}; NAS 2009) and other systems (Castel et al. 1989; Nuges et al. 1996; Christensen et al. 2003; Lu and Grant 2008) have noted that the abundance of certain benthic species is lower beneath oyster racks relative to other natural habitats, such as nearby eelgrass beds (see discussion under alternative B). Therefore, the removal of DBOC offshore infrastructure would be expected to result in a slight increase in native benthic invertebrate abundance where the racks are currently located, mostly due to the expected regrowth of eelgrass in these areas. In addition, the termination of bottom bag culture in Drakes Estero would remove bags that can occupy up to 84 acres of space, reopening habitat for native benthic fauna that is currently being covered by the bags (NAS 2009).

As noted by the NAS (2009), bottom bag culture provides structured habitat for some benthic invertebrates. Although removal of the bags would result in a short-term adverse impact on benthic organisms that colonize the bags, alternative natural habitats (e.g., mudflats, sandbars or eelgrass beds) are expected to replace these structures. In addition, DBOC's regular practice of flipping the bags on the substrate directly disrupts the colonization by temporary physical displacement (i.e., disruption of bag contents and the substrate underneath). Further, when the bags are harvested, any native benthic organisms that have colonized the bags are also harvested, brought onshore along with the cultured bivalves, and killed during processing—a case of accidental mortality referred to as “non-catch mortality” (Kaiser 2001) (see discussion under alternative B). Under alternative A, the termination of DBOC activities in Drakes Estero would remove the potential for non-catch mortality.

Finally, under alternative A the potential for substrate disturbance related to DBOC boat traffic in the main channel of Schooner Bay would no longer be present. Therefore, to the extent that such activities cause direct destruction of native benthic fauna by boat propellers or indirect displacement by disruption of benthic sediments. Further, the potential for disruption of benthic fauna and benthic habitat from dredging would no longer exist (see discussion under alternative B). The removal of such activities would result in beneficial impacts on benthic fauna.

As described above, alternative A would result in long-term beneficial impacts on benthic fauna because the termination of DBOC operations and associated commercial shellfish activities within Drakes Estero would remove nonnative species from Drakes Estero, reduce risk for the spread of nonnative and invasive species in the future, reopen habitat for native benthic fauna that is currently being covered by bags, and eliminate the potential for substrate disturbance related to DBOC boat traffic, as well as disruption due to dredging.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact benthic fauna within the project area. These actions include monitoring/managing invasive species, coastal watershed

restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative.

Monitoring and management of invasive species could include management of invasive species detrimental to native benthic invertebrates living in Drakes Estero. Such management activities could result in beneficial impacts on native benthic fauna. For example, the management of invasive tunicates (*Didemnum* spp.), which are already found in Drakes Estero, would benefit native invertebrates because the tunicates have the capacity to completely overgrow benthic invertebrates and inhibit their normal biological functions. Recent coastal watershed restoration efforts within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) could improve water quality within Drakes Estero. Water quality improvements associated with these projects, such as reduced sedimentation in Drakes Estero, would result in beneficial impacts on native benthic fauna. The MLPA prohibits the take of any living marine resource within a marine protection area except recreational clam gathering and commercial shellfish aquaculture. Alternative A, in combination with the MLPA would result in only recreational clamming allowed within the Estero. Efforts associated with the MLPA have had and will continue to have a beneficial impact on native benthic fauna.

The beneficial impacts of these past, present, and reasonably foreseeable future action, combined with the long-term beneficial impacts of alternative A would result in a long-term beneficial cumulative impact on native benthic fauna. Alternative A would contribute an appreciable beneficial increment to the overall beneficial cumulative impacts to native benthic fauna.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on native benthic fauna because the termination of DBOC operations and associated mariculture activities within Drakes Estero would remove nonnative species from Drakes Estero and reduce risk for the spread of nonnative and invasive species in the future. Alternative A would result in the removal of mariculture structures supporting more than 10 million oysters currently growing in Drakes Estero, as well as several hundred thousand Manila clams in bags. Although some habitat for certain benthic species would be removed when DBOC's offshore infrastructure is removed, alternative natural habitats (e.g., eelgrass beds) are expected to replace these structures. Further, the removal of structures under alternative A would also remove substrates that support invasive tunicates and other fouling species. Several native benthic species, such as bivalves, polychaete worms, and ostracods would benefit from the removal of offshore infrastructure, particularly up to 88 acres of mudflats and sandbars where bottom bags can be placed (22 acres have been planted with bottom bags each of the past two years). Such species are adapted to the soft bottom habitat and eelgrass that would likely replace the mariculture structures once they are removed. The cumulative impact would be beneficial, and alternative A would contribute an appreciable beneficial increment to the beneficial cumulative impact.

Alternative A would be consistent with the guidance set forth in NPS *Management Policies 2006* for the maintenance and restoration of natural native ecosystems, including the eradication of exotic species where these species interfere with natural processes and habitat (NPS 2006d).

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact benthic fauna include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Production limited at 600,000 pounds of shellfish per year
- Species cultivated could include:
 - Permit Area 1: Pacific oysters, European flat oysters, and Manila clams
 - Permit Area 2: purple-hinged rock scallops

Based on research conducted within Drakes Estero, the relative abundance of certain benthic invertebrates (i.e., the relative numbers of individuals within each species) was found to be lower directly underneath oyster racks than in nearby eelgrass habitat (Harbin-Ireland 2004^{viii}; NAS 2009). Harbin-Ireland (2004^{ix}) suggests that this decreased abundance is due to the fact that benthic habitat underneath oyster racks is more exposed to predators (such as fish) that prey on invertebrates living in the substrate. They further attributed the increased exposure to a lack of sufficient eelgrass cover, a phenomenon also observed by Everett, Ruiz, and Carlton (1995) underneath oyster racks in Coos Bay, Oregon.

Studies of bivalve mariculture in Europe (Castel et al. 1989; Nugues et al. 1996), New Zealand (Christensen et al. 2003), and Canada (Lu and Grant 2008) have noted similar reductions in benthic macroinvertebrates under structures or beds. In each of these studies, changes in the quality of the substrate, such as modification of texture due to erosion or sedimentation, or decrease in oxygen availability, were implicated as causing reductions in benthic invertebrates. Though Harbin-Ireland (2004^x) did not detect appreciable differences in sediment chemistry between oyster racks and eelgrass habitat (NAS 2009), changes in sediment texture were noted, indicating that erosion had taken place underneath the racks.

According to bed size and culture type provided by DBOC, a maximum of 84 acres of bottom bags may be placed within Drakes Estero at any given time (DBOC 2010a, 2010b). Alternative B would not result in the expansion of existing beds; therefore, 84 acres would remain the maximum coverage of bottom bags. The actual number varies year to year and is likely to be less than 84 acres because floating bags also are used in some of these beds. According to DBOC proof-of-use reports, 22 acres of bags were planted each of the past 2 years. Oysters and other bivalves cultured in bags on sandbars and mudflats have the potential to cover space that would otherwise be available for native benthic organisms to inhabit, particularly those that burrow in the soft substrate. However, some studies in west coast estuaries have shown that benthic invertebrate diversity can be higher near oyster beds than in adjacent unstructured habitat (NAS 2009). In one such study in Willapa Bay, Washington, benthic invertebrate densities were higher in on-bottom oyster beds than in adjacent mudflats, although both oyster and mudflat habitats showed lower diversity and density than eelgrass habitat (Hosack et al. 2006). To the extent that bottom bag bivalve cultivation provides habitat for benthic invertebrates, the bag culture method used by DBOC in Drakes Estero provides a potential artificial habitat for benthic invertebrates.

However, it should be noted that this approach is not consistent with NPS management policies, which are focused on protection of native species and natural processes. Further, commercial shellfish operations regularly disrupt this artificial habitat by turning the bags over on the substrate. This takes place approximately once a month for Pacific oysters. Manila clam bags do not require turning (DBOC [Lunny], pers. comm., 2011h).

Turning the bags over on the substrate has the potential to disrupt native benthic organisms living on or underneath the bags. Such disruption can also occur during storm events when the bags become dislodged from their locations on the mudflats. Additionally, native benthic organisms living in these bags are harvested along with the market-ready bivalves when the bags are lifted from the substrate and brought onshore for processing. Native benthic invertebrates unintentionally captured in this manner are killed in the process of harvesting the cultured oysters and clams. Such non-catch mortality can cause a loss of native benthic invertebrates (Kaiser 2001; Kaiser et al. 1998).

The Pacific oyster, which is the primary species cultured by DBOC, is not native to the Northern California region (Trimble, Ruesink, and Dumbauld 2009). Similarly, the Manila clam, a recent introduction into DBOC's shellfish cultivation stock and a species that could be produced on a much wider scale under this alternative than under existing conditions, is a nonnative species. Such introductions have the potential to develop naturally breeding populations in Drakes Estero (NAS 2004, 2009). The introduction of commercially grown nonnative bivalve species carries a certain level of risk that the nonnative species would compete with native bivalves for food or habitat, leading to a decrease in local biodiversity of native bivalve species (Ruesink et al. 2005; Trimble, Ruesink, and Dumbauld 2009; Dumbauld, Ruesink, and Rumrill 2009; NAS 2010). The phenomenon of native species displacement has already been observed for the Manila clam (Pranovi et al. 2006), the native Olympia oyster (Trimble, Ruesink, and Dumbauld 2009) and other species introductions on the west coast (Ruesink et al. 2005).

A production level of 600,000 pounds per year under alternative B would result in approximately 7.06 million individual shellfish (based on calculations for Pacific oysters) being added to and subsequently extracted from Drakes Estero annually. This level of annual production would sustain the current risk for naturalization of cultured nonnative species into Drakes Estero (NAS 2004).

Although DBOC does not currently cultivate European flat oysters, they are permitted to do so. This species is native to the coastal waters of Europe, and has recently been identified as an invasive species in New England where it was introduced as a mariculture species in the mid 1900s (Carlton 1999). There is no record of European flat oyster establishing reproducing populations in the central California coast (Carlton n.d., as quoted in Grosholz 2011a)

While bivalve mariculture can be used in certain settings to manipulate and modify systems with poor water quality (NAS 2009), such manipulation is not consistent with NPS management policies. Further, although introduced bivalves have been shown to have beneficial ecosystem impacts in certain settings through nutrient processing and organic enrichment of sediments (Newell 2004), the nutrient cycle in west coast estuaries (such as Drakes Estero) is controlled by the tides and the important ocean-derived nutrients from upwelling currents—a condition on which filter-feeding bivalves would have limited influence (Dumbauld, Ruesink, and Rumrill 2009). Also, since the dominant eelgrass population in Drakes Estero controls the cycling of organic material to the sediments (NAS 2009), any organic contributions from introduced bivalves would be negligible by comparison.

NAS (2009) pointed out that historic importation of the Pacific oyster on cultch has resulted in the introduction of other nonnative species to the region, such as the pathogen *Haplosporidium nelsoni* (MSX) (Friedman 1996; Bureson and Ford 2004), as well as herpes viral infections (Friedman et al. 2005; Burge et al. 2005). Introduced shellfish diseases pose a threat to native populations of bivalves (NAS 2004; Burge, Griffin, and Freidman 2006; NAS 2010). For commercial shellfish operations, the importation of seed from outside sources requires a permit, which is administered through the CDFG. California Fish and Game Code section 2270 prohibits the importation of seed from infected or diseased areas.

Under alternative B, the potential species cultivated by DBOC would remain the same, with the Pacific oyster and the Manila clam representing the principal species stocked. However, DBOC would maintain a 1-acre plot (Area 2, formerly known as Lease M-438-02) for growing purple-hinged rock scallops, a species that is native to the Pacific coast (Kozloff 1983). Although DBOC has not provided details about the specific cultivation methods for scallops, it is assumed that a structure (e.g., rack, floating tray) would be required because scallops normally require attachment to a hard substrate for grow-out (Culver, Richards, and Page 2006). The impacts on benthic fauna associated with scallop grow-out structures are expected to be similar to those currently used by DBOC for other species. In addition, because Drakes Estero is predominantly a soft-bottomed estuary with minimal hard substrate (Anima 1991^{xi}; Press 2005), adult purple-hinged rock scallops are not likely to be found naturally growing in abundance within Drakes Estero due to the hard surface attachment requirement. Therefore, although the species is native to the region, it is most likely to occur naturally in Drakes Estero only in larval form and cultivation of scallops would not contribute to a population of a native, naturally occurring species.

Of particular concern is the invasive colonial tunicate *Didemnum* (Lambert 2009), which has already been observed in association with DBOC's offshore infrastructure (NAS 2009). Because of this species' potential to smother habitats and inhibit normal biological functions in benthic fauna (Osman and Whitlatch 2007; Mercer, Whitlatch, and Osman 2009), it has become a major concern on both North American coasts (Bullard, Lambert, et al. 2007). Further, the ability of *Didemnum* to regenerate after being fragmented increases its dispersal capabilities (Bullard, Sedlack, et al. 2007), which can be exacerbated by maintenance of oyster bags and racks (NAS 2009). In California (Foss et al. 2007; Heiman 2006), as elsewhere (Dijkstra, Sherman, and Harris 2007; Dijkstra, Harris, and Westerman 2007), invasive tunicates have been shown to reduce local biodiversity by displacing natural habitats and reducing the availability of resources used by multiple species. Because shellfish mariculture is the most likely mode of introduction for invasive tunicates on the west coast (Herborg, O'Hara, and Therriault 2009), these invaders, which have already been identified on native substrates within Drakes Estero, are likely to remain a problematic species in estuaries where shellfish mariculture is practiced.

In addition, Byers (1999) studied the invasion of a nonnative mud snail (*Batillaria attramentaria*), making specific reference to its introduction by JOC, the previous oyster operator in Drakes Estero. This organism was found to be detrimental to native snail populations (NAS 2009).

Finally, under alternative B the potential for substrate disturbance related to DBOC boat traffic in the main channel of Schooner Bay would continue (Anima 1991^{xii}). Therefore, to the extent that such activities cause direct destruction of native benthic fauna by boat propellers or indirect displacement by disruption of benthic sediments, the continuation of such commercial activities would result in adverse impacts on benthic fauna. Under alternative B, dredging would take place once in an area approximately 30 feet by 60 feet to a depth of approximately 3 feet under and surrounding the floating dock. Dredging

would result in adverse impacts on benthic fauna living within the substrate in this portion of Drakes Estero, either through physical destruction or displacement of benthic organisms or through displacement of organisms.

As described above, issuance of a 10-year SUP under alternative B would result in long-term moderate adverse impacts on benthic fauna for another 10 years because of DBOC operations and associated human activities within Drakes Estero have the potential to serve as vectors for introduction of nonnative invasive species and disease and to cause physical disturbance to native benthic fauna and their habitat. These impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to benthic fauna in Drakes Estero. Particularly, the cessation of bag cultivation in Drakes Estero would remove structured habitat for some benthic invertebrates (although alternative natural habitats such as eelgrass beds are expected to replace these structures), and would eliminate “non-catch mortality.” In addition, removal of offshore infrastructure would reduce the potential for *Didemnum* colonization, and removal of associated mariculture activities (such as infrastructure maintenance, vessel traffic, and harvesting) would reduce the risk for further dispersal of this nonnative invasive tunicate via colonial fragments. Although shellfish operations would cease in 2022, the additional 10 years of nonnative shellfish cultivation within Drakes Estero under alternative B may allow these shellfish species to become further established in the Drakes Estero benthic community. For instance, Manila clam is not native to the Pacific coast however a reproducing population has been observed in Drakes Estero (Grosholz 2011b). Prolonging the presence of these nonnative shellfish under alternative B could hinder NPS efforts at invasive species management in Drakes Estero and could lengthen the period of time before a natural benthic faunal community could be re-established, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the shellfish operation.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact native benthic fauna within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include monitoring and management of invasive species, coastal watershed restoration (Geomorphologic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the MLPA as described under alternative A.

For the same reasons discussed in the cumulative impact analysis for alternative A, these past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts to native benthic fauna. The impacts of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative B, would result in a long-term moderate adverse cumulative impact on benthic fauna. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative B would result in long-term moderate adverse impacts on native benthic fauna due to an additional 10 years of DBOC operations and associated human activities within Drakes Estero, and the potential for such activities to serve as vectors for introduction of nonnative invasive species. Specifically, the cultivation of nonnative species within Drakes Estero at production levels of 600,000 pounds of shellfish meat annually would result in approximately 7.06 million individual organisms being added to and subsequently harvested from Drakes Estero on an annual basis. Based on DBOC proof of use reports, the acreage of sand bars and mudflats occupied at this level of production is 50 percent greater than that reported for 2008 in the 2009 NAS report. This would appreciably affect the natural benthic community, the consequences of which could include nonnative species competitively excluding native species of bivalves and other benthic organisms, introduction of molluscan diseases, and other harmful nonnative species being imported unintentionally (such as the invasive tunicate *Didemnum*). Use of both bottom bags and racks has been implicated in detectable changes in benthic communities. The maintenance and continued use of DBOC offshore infrastructure would result in a slight decrease in benthic invertebrate abundance where the racks are currently located, owing mostly to the lack of eelgrass in these areas. In addition, the continuation of bag cultivation in Drakes Estero would maintain artificial structured habitat for some benthic invertebrates, but would also allow for non-catch mortality to continue, as described above, which would have an adverse impact on native bivalves. Further, the continued use of offshore infrastructure would maintain the potential for *Didemnum* expansion, and associated mariculture activities (such as infrastructure maintenance, vessel traffic, and harvesting) would pose a risk for further dispersal of this nonnative invasive tunicate via colonial fragments. The potential for increase in overall cover of *Didemnum* would have an adverse impact on species diversity. Lastly, the nonnative Manila clam would be produced on a much wider scale under this alternative than under existing conditions, which increases the chance of naturally breeding populations of this species becoming established in Drakes Estero (NAS 2004, 2009). These impacts would be clearly detectable and could appreciably affect individual species, communities, or natural processes. The cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

The introduction and maintenance of nonnative species in Drakes Estero does not further the goal of NPS *Management Policies 2006*, which is to minimize the impacts of human activities on native benthic fauna populations. All species that could be cultivated are nonnative with the exception of the purple-hinged rock scallop, which is native to the rocky California coast but is only likely to be found in Drakes Estero in larval form.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact benthic fauna are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact benthic fauna include:

- A production limit of 500,000 pounds of shellfish per year

- Species cultivated could include:
 - Permit Area 1: Pacific oysters and European flat oysters
 - Permit Area 2: purple-hinged rock scallops and Manila clams

Impacts associated with alternative C would be expected to be similar to those described under alternative B, with the following exceptions. Under alternative C, the Pacific oyster would be the primary species cultured by DBOC throughout the approximately 138 acres of cultivation beds within the offshore permit area (Area 1), with Manila clams being limited to the 1-acre plot in Area 2. In addition to Manila clams, purple-hinged rock scallops would be cultured in Area 2. The reduction in the area over which Manila clams would be cultured under alternative C (compared to alternative B) would reduce the potential for this nonnative species to become established in Drakes Estero and thereby preempt native bivalves and other benthic fauna. The submerged lands in Area 2 do not contain sandbars, further reducing the risk of Manila clam naturalization under alternative C. The potential risk of nonnative bivalves establishing breeding populations within Drakes Estero is discussed in detail under alternative B. The reduction in shellfish production levels from 600,000 pounds under alternative B to 500,000 pounds under alternative C would result in a slight decrease in the impacts on benthic fauna described under alternative B due to the lower levels of production and the presumably lower number of cultured organisms in Drakes Estero (estimated at 5.88 million individuals).

As described above, alternative C would result in long-term moderate adverse impacts on benthic fauna, for another 10 years because of DBOC operations and associated human activities within Drakes Estero, and the potential for such activities to serve as vectors for introduction of nonnative invasive species and disease. These impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.

As described under alternative B, upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to benthic fauna in Drakes Estero. Although shellfish operations would cease in 2022, the additional 10 years of nonnative species cultivation within Drakes Estero under alternative C may allow these nonnative species to become further established in the Drakes Estero benthic community (as mentioned above, purple-hinged rock scallops are native to the California coast but may not naturally grow in Drakes Estero). Prolonging the presence of these species under alternative C could hinder NPS efforts at invasive species management in Drakes Estero and could lengthen the period of time before a natural benthic faunal community could be re-established, as compared to alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact native benthic fauna within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include monitoring and management of invasive species, coastal watershed restoration (Geomorphologic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the MLPA as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, these past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts to native benthic fauna. The beneficial impacts of these past, present, and reasonably foreseeable future actions, when combined with the long-term

moderate adverse impacts of alternative C, would result in a long-term moderate adverse cumulative impact on native benthic fauna. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative C would result in long-term moderate adverse impacts on benthic fauna due to an additional 10 years of commercial shellfish operations and associated human activities within Drakes Estero, and the potential for such activities to serve as vectors for introduction of nonnative invasive species. Specifically, production levels under alternative C (500,000 pounds of shellfish meat) would result in 5.88 million individuals being harvested from Drakes Estero annually. The cultivation of nonnative species within Drakes Estero would appreciably affect the communities of the natural benthic community, including introduction of molluscan diseases and other nonnative species imported unintentionally (such as the invasive tunicate *Didemnum*). However, the area in which Manila clams will be grown is a small area where no sandbars exist, which would limit the potential for this species to naturalize in Drakes Estero as compared with alternatives B and D. The use of both bottom bags and racks has been implicated in detectable changes in benthic communities. The slight reduction in shellfish production levels between alternative B (600,000 pounds) and alternative C (500,000 pounds) indicates that the level of impact on benthic fauna resulting from alternative C would be slightly less than that from alternative B; however, these impacts would be clearly detectable and could appreciably affect the individual species, communities, or natural processes. Cumulative impacts would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

The introduction and maintenance of nonnative species in Drakes Estero does not further the goal of NPS *Management Policies 2006*, which is to minimize the impacts of human activities on native benthic fauna populations. All species that could be cultivated are nonnative with the exception of the purple-hinged rock scallop, which is native to the rocky California coast but is only likely to be found in Drakes Estero in larval form.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact benthic fauna are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact benthic fauna include:

- Production limit of 850,000 pounds of shellfish per year
- Species cultivated could include: Pacific oysters, Olympia oysters, European flat oysters, Manila clams, and purple-hinged rock scallops

Impacts associated with offshore DBOC operations and facilities under alternative D would be expected to be similar to those described under alternative B, with a few exceptions. Under alternative D, the range

of species cultured by DBOC would be expanded from the Pacific oyster, European flat oyster, Manila clam, and the purple-hinged rock scallop to also include the Olympia oyster. This would increase the diversity of species offered by DBOC for market, but would not increase the area within Drakes Estero over which shellfish are cultured. Manila clams are not native to the Pacific coast of North America, and have been shown to naturalize in areas where they have been introduced (Humphreys et al. 2007). Similar to the purple-hinged rock scallop (see discussion under alternative B), the Olympia oyster is native to the Pacific coast (Kozloff 1983), but it too requires a hard substrate for colonization and grow-out (Couch and Hassler 1989; Trimble, Ruesink, and Dumbauld 2009). As such, adult Olympia oysters are not likely to be found naturally growing in abundance within Drakes Estero due to the hard surface attachment requirement. Inspections within Drakes Estero during the 1930s, as documented by Bonnot (1935), found no Olympia oysters growing in Drakes Estero. The historic presence of Olympia oysters in Drakes Estero has also been the subject of recent archeological work (Konzak and Praetzelis 2011), which found that Olympia oysters were of limited distribution in Drakes Estero even prior to the advent of large-scale commercial fishing on the California coast. Therefore, although the species is native to the region, it is most likely to occur naturally in Drakes Estero in larval form. The impact of such introductions would depend on the proportion of the native and nonnative species cultivated under alternative D, which are unknown at this time. Finally, under alternative D, DBOC has sought permission to collect the larvae for Olympia oysters and purple-hinged rock scallops directly from Drakes Estero. The collection of larvae is not consistent with NPS *Management Policies 2006* (NPS 2006d) or with NPS regulations, which prohibit the collection of shellfish larvae (36 CFR 2.1 et seq.).

Under alternative D, shellfish production levels would be increased to 850,000 pounds. This is a substantial increase from alternative C (500,000 pounds) and alternative B (600,000 pounds). Alternative D would result in the largest impact on benthic fauna when compared with alternatives B and C, due to the higher levels of production and, presumably, the higher number of cultured organisms in Drakes Estero (estimated at 10 million individuals harvested annually). This would be the highest documented level of commercial production of shellfish in Drakes Estero, and accordingly, the risk of naturalization of nonnative species would be greater.

As described above, alternative D would result in long-term moderate adverse impacts on benthic fauna for another 10 years because of DBOC operations and associated human activities within Drakes Estero and the potential for such activities to serve as vectors for introduction of nonnative invasive species. These impacts would be clearly detectable and could appreciably affect the individual species, communities, or natural processes.

Similar to the other action alternatives, upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to native benthic fauna in Drakes Estero. Although shellfish operations would cease in 2022, the additional 10 years of nonnative species cultivation within Drakes Estero under alternative D may allow these nonnative species to become further established in the Drakes Estero benthic community (as mentioned above, purple-hinged rock scallops are native to the California coast but may not naturally grow in Drakes Estero, and Olympia oyster is native but may not be found in great numbers in a primarily sandy-bottom estuary like Drakes Estero). Prolonging the presence of these species under alternative D could hinder NPS efforts at invasive species management in Drakes Estero and could lengthen the period of time before a natural benthic faunal community could be re-established, as compared to alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact benthic fauna within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include monitoring and management of invasive species, coastal watershed restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the MLPA as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, these past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts to native benthic fauna. The beneficial impacts of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative D, would result in a long-term adverse cumulative impact on native benthic fauna. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative D would result in long-term moderate adverse impacts on native benthic fauna due to an additional 10 years of DBOC operations and associated human activities within Drakes Estero, and the potential for such activities to serve as vectors for introduction of nonnative invasive species. Specifically, the increase in shellfish production levels to 850,000 pounds shucked weight (approximately 10 million individual organisms harvested annually) represents a marked increase over alternatives B and C (approximately 40 percent greater than alternative B and 70 percent greater than alternative C); therefore, it is assumed alternative D would result in the greatest level of impact on native benthic fauna among all alternatives. The cultivation of nonnative species within Drakes Estero would appreciably affect the natural benthic community, including introduction and spread of molluscan diseases and other nonnative species imported unintentionally (such as the invasive tunicate *Didemnum*). While certain species introduced under alternative D are native to the region (e.g., purple-hinged rock scallops and Olympia oysters), they are not readily present in Drakes Estero in adult form. The use of both bottom bags and racks has been implicated in detectable changes in benthic communities. These impacts would be clearly detectable and could appreciably affect the individual species, communities, or natural processes. Cumulative impacts would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

The introduction and maintenance of nonnative species in Drakes Estero does not further the goal of NPS *Management Policies 2006*, which is to minimize the impacts of human activities on native benthic fauna populations. All species that could be cultivated are nonnative with the exception of the purple-hinged rock scallop, which is native to the rocky California coast but is only likely to be found in Drakes Estero in larval form, and the Olympia oyster, which also prefers a hard substrate and is not present in Drakes Estero in large numbers. Additionally, DBOC's proposal to collect native shellfish larvae within Drakes Estero would not be consistent with the NPS mission, per *Management Policies 2006* (NPS 2006d) or regulations.

IMPACTS ON WILDLIFE AND WILDLIFE HABITAT: FISH

LAWS AND POLICIES

NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4 et seq.) states that “the National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems.” Directives for maintaining native species include “preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and, minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them.” At the forefront of NPS biological resource management philosophy is the goal of preserving the genetic stock of wildlife species naturally occurring within park lands, as stated under section 4.4.1.2: “The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity” (NPS 2006d).

The Magnuson-Stevens Fishery Conservation and Management Act, as implemented by NMFS, requires that fishery management plans identify and describe essential fish habitat. The Pacific Fishery Management Council’s Groundfish Plan has identified seagrasses (such as the eelgrass beds in Drakes Estero) as essential fish habitat for groundfish species. Further, seagrasses are distinguished as habitat areas of particular concern, which is a subset of essential fish habitat that requires additional scrutiny during the consultation process. Impacts on essential fish habitat were discussed in detail under “Impacts on Eelgrass” above.

METHODOLOGY

This section summarizes the impacts on fish from those actions that could potentially occur from each alternative. In consideration of the different types of fish species within the project area discussed in chapter 3, impacts are evaluated in the context of the type of impact (direct, indirect), the nature of the impact (i.e., type of disturbance to wildlife and wildlife habitat), the quality and amount of fish habitat impacted, and the potential for risks posed by proposed actions (e.g., introduction of nonnative species).

Intensity Definitions

Minor:	Impacts would be localized and slightly detectable, but would not affect the overall structure of any natural community.
Moderate:	Impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.
Major:	Impacts would be highly noticeable and would substantially influence natural resources, e.g., individuals or groups of species, communities, or natural processes.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including mariculture infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

As described above, eelgrass habitat is designated in the Groundfish Plan as essential fish habitat for fish species (including but not limited to various species of sharks and skates, roundfish, rockfish, and flatfish). Impacts on eelgrass habitat from oyster mariculture activities would be eliminated under alternative A, allowing eelgrass habitat to expand into areas previously lacking in habitat due to the combination of factors discussed in this chapter under “Impacts on Eelgrass.”

This expansion of eelgrass habitat would result in a beneficial impact on fish species in the Groundfish Plan. Some species of roundfish and flatfish, such as lingcod (*Ophiodon elongatus*) and English sole (*Parophrys vetulus*), feed on a variety of prey that can be associated with eelgrass habitat (PFMC 2008). Eelgrass also provides increased cover from predators for smaller groundfish species that are prey to piscivorous fish and birds. As such, expansion of eelgrass beds may benefit groundfish species in Drakes Estero by increasing their food supply and opportunity for predator avoidance.

Shellfish mariculture structures within Drakes Estero provide habitat for structure-oriented fish such as the kelp surfperch (Wechsler 2004^{xiii}) (see discussion under alternative B). However, Drakes Estero is naturally a soft-bottomed estuary with little structure; therefore, DBOC's offshore infrastructure is a non-natural habitat type. Similar to natural habitat types, such as dense stands of kelp preferred by the kelp surfperch, the non-natural habitat provided by DBOC offshore structures attracts prey of structure-oriented fish species. Therefore, the removal of DBOC's shellfish infrastructure would reduce the availability of prey for structure-oriented fish species, which would likely result in localized decreases in the abundance of these types of fish species.

The removal of approximately 2,140 bents associated with the oyster racks within Drakes Estero during DBOC close out procedures in 2012 would result in temporary increases in turbidity for the one to two months it would take to remove them. This would cause highly localized and temporary disruptions to fish within the vicinity of the removal. Fish would be expected to temporarily relocate to other areas of Drakes Estero during such disruption.

In the long term, the removal of approximately 7 acres of oyster racks from Drakes Estero is likely to result in regrowth of eelgrass in currently impacted areas. As such, natural fish habitats (eelgrass beds) would be expected to replace the structures once removed, thus increasing the presence of fish that favor this natural habitat. The removal of shellfish mariculture infrastructure from Drakes Estero would be expected to result in a shift in fish species composition where these features are currently located. This shift would return the ecosystem to a more natural state.

As described above, alternative A would result in long-term beneficial impacts because the restoration of natural fish habitat, particularly those attributed to Pacific groundfish habitat in the Groundfish Plan,

would provide increased cover for fish from piscivorous birds and other fish as well as increased prey for larger groundfish; and, in doing so, would restore the natural ecosystem.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact fish within the project area. These actions include restoration of the developed onshore area following SUP expiration, coastal watershed restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative.

Restoration of the developed onshore area following SUP expiration would include wetlands restoration practices that would improve fish habitat areas affecting approximately 5 acres. Intertidal wetlands provide potential habitat for some fish that live in Drakes Estero. These restoration efforts would result in long-term beneficial impacts on fish. Recent coastal watershed restoration efforts within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) could enhance eelgrass habitat within Drakes Estero due to improved watershed conditions. As such, watershed restoration efforts within the Drakes Estero watershed could result in long-term beneficial impacts on fish. The MLPA prohibits the take of any living marine resource within a marine protection area, except recreational clam gathering and commercial shellfish aquaculture. Alternative A, in combination with the MLPA would result in only recreational clamming allowed within the Estero. Fishing, either recreationally or commercially, is prohibited under the act; therefore, the MLPA would have a beneficial impact on fish.

Based on the information above, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The beneficial impact of past, present, and reasonably foreseeable future actions, when combined with the long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on fish. Alternative A would contribute a noticeable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on fish due to the restoration of natural fish habitat, particularly those attributed to Pacific groundfish habitat in the Groundfish Plan, which in turn would provide increased cover for fish from piscivorous birds and other fish as well as increased prey for larger groundfish. Alternative A would result in a more natural species composition within the project area. Alternative A also would result in short-term minor adverse impacts because disruption of fish during rack removal from Drakes Estero would be localized and slightly detectable, but would not affect the overall structure of any natural community. The cumulative impact would be beneficial, and alternative A would contribute a noticeable beneficial increment to the overall cumulative impact.

Alternative A would be consistent with the guidance set forth in NPS *Management Policies 2006* for the maintenance and restoration of natural native ecosystems, including restoration of native fish communities (NPS 2006d). Additionally, this alternative would be consistent with the goals set forth in the Magnuson-Stevens Fishery Conservation and Management Act because the essential fish habitat

(habitat of particular concern) designated within the Pacific Fishery Management Council's Groundfish Management Plan would be maintained and improved.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact fish include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

The impacts on fish are related to impacts on eelgrass, which is fish habitat. Impacts related to eelgrass are detailed in the "Impacts on Eelgrass" section of this chapter. These activities would have an adverse impact on fish habitat, particularly as it relates to the Groundfish Plan and Pacific herring. This impact on fish habitat would affect species listed under the Groundfish Plan, including several species of sharks and skates, roundfish, rockfish, and flatfish. As mentioned under alternative A, certain species of groundfish rely on prey that inhabit eelgrass beds. Other groundfish use eelgrass habitat to seek refuge from predatory birds and fish.

In a study of shellfish mariculture on fish populations in Drakes Estero, Wechsler (2004^{xiv}) noted that DBOC's commercial shellfish infrastructure had little effect on fish species abundance or community composition when compared with other habitats. The main trend noted was an increase in structure-oriented fish such as kelp surfperch (*Brachyistius frenatus*). The idea that the structure from oyster racks provides habitat for certain fish also is supported elsewhere in the literature (e.g., Pinnix et al. 2005; NAS 2009).

As mentioned under alternative A, the 95 wooden shellfish cultivation racks, totaling approximately 5 miles (7 acres) within Drakes Estero, displace natural eelgrass habitat and provide non-natural habitat that attracts preferred prey species of structure-oriented fish. The continued presence of DBOC's offshore infrastructure under alternative B would continue to provide non-natural structured habitat which can be favored by a structure-oriented species, such as the kelp surfperch. In natural circumstances, kelp surfperch are normally found in structured habitats created by dense stands of kelp (*Macrocystis* spp.). Because Drakes Estero is naturally a soft-bottomed estuary with little structure, this species would not normally be expected to be as abundant due to a lack of suitable habitat.

As described above, alternative B would result in long-term minor adverse impacts on fish for an additional 10 years because while the natural species composition would remain altered due to the presence of non-natural structured habitat, impacts would be localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community.

Upon expiration of the SUP in 2022, DBOC's removal of the shellfish racks from Drakes Estero and the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to fish in Drakes Estero. Impacts on fish associated with

conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact fish within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include coastal watershed restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of past, present, and reasonably foreseeable future actions would be long-term beneficial. The beneficial impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative B would result in a long-term beneficial cumulative impact on fish. Alternative B would contribute a noticeable adverse increment to the overall beneficial cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on fish beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative B would result in long-term minor adverse impacts on fish because while the natural species composition would remain altered due to the presence of non-natural structured habitat, impacts would be relatively localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community. The maintenance of shellfish racks would continue to displace approximately 7 acres of natural fish habitat which would otherwise provide increased cover for fish from piscivorous birds and other fish as well as increased prey for larger groundfish, particularly those attributed to Pacific groundfish habitat in the Groundfish Plan. The cumulative impact would be long-term beneficial, and alternative B would contribute a noticeable adverse increment to the overall beneficial cumulative impact.

With regards to fish, continued operation of DBOC for 10 additional years would not be consistent with relevant law and policy. The continued maintenance of a non-natural community in Drakes Estero does not further the goal of *NPS Management Policies 2006* to preserve and restore natural communities and ecosystems. Perpetuation of non-natural habitat would continue to attract fish communities that would not naturally be found in Drakes Estero. Additionally, this alternative would not be consistent with the goals set forth in the Magnuson-Stevens Fishery Conservation and Management Act because damage to eelgrass designated as essential fish habitat (habitat of particular concern) within the Pacific Fishery Management Council's Groundfish Management Plan would continue.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact fish are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC's racks and bags would occupy the same space as under alternative B. A change in the production limit to 500,000 pounds of shellfish per year, as compared to 600,000 pounds per year under alternative B is also not expected to result in any difference in impacts as there is no proposal to expand racks beyond current areas. Under alternative C, the impact on fish would be the same as described under alternative B. Impacts on the eelgrass, which functions as Pacific groundfish essential fish habitat are detailed in the "Impacts on Eelgrass" section of this chapter. Existing eelgrass habitat would continue to provide prey and cover for Pacific groundfish. DBOC's continued use of the 95 wooden racks, totaling approximately 5 miles (7 acres) within Drakes Estero, would continue to displace natural eelgrass habitat and would provide non-natural structured habitat that would continue to attract prey for fish species such as kelp surfperch.

As described above, alternative C would result in long-term minor adverse impacts on fish for an additional 10 years because while the natural species composition would remain altered due to the presence of non-natural structured habitat, impacts would be localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community.

Upon expiration of the SUP in 2022, DBOC's removal of the shellfish racks from Drakes Estero and the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to fish in Drakes Estero. Impacts on fish associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact fish within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include coastal watershed restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of past, present, and reasonably foreseeable future actions would be long-term beneficial. The beneficial impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative C would result in a long-term beneficial cumulative impact on fish. Alternative C would contribute a noticeable adverse increment to the beneficial cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on fish beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative C would result in long-term minor adverse impacts on fish because while the natural species composition would remain altered due to the presence of non-natural structured habitat, impacts would be relatively localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community. The maintenance of shellfish racks would continue to displace approximately 7 acres of natural fish habitat which would otherwise provide increased cover for fish from piscivorous birds and other fish as well as increased prey for larger groundfish, particularly those attributed to Pacific groundfish habitat in the Groundfish Plan. The cumulative impact would be long-term beneficial, and alternative C would contribute a noticeable adverse increment to the overall beneficial cumulative impact.

With regards to fish, continued operation of DBOC for 10 additional years would not be consistent with relevant law and policy. The continued maintenance of a non-natural community in Drakes Estero does not further the goal of NPS *Management Policies 2006* to preserve and restore natural communities and ecosystems. Perpetuation of non-natural habitat would continue to attract fish communities that would not naturally be found in Drakes Estero. Additionally, this alternative would not be consistent with the goals set forth in the Magnuson-Stevens Fishery Conservation and Management Act because damage to eelgrass designated as essential fish habitat (habitat of particular concern) within the Pacific Fishery Management Council's Groundfish Management Plan would continue.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact fish are the same as described under alternative B. The offshore SUP boundaries would be slightly larger than alternative B; however, DBOC's racks and bags would generally occupy the same space as under alternative B. A change in the production limit to 850,000 pounds of shellfish per year is not expected to result in any difference in impacts because there is no proposal to expand racks beyond current areas.

Under alternative D, the impact on fish would be the same as described under alternative B. Impacts on the eelgrass, which functions as Pacific groundfish essential fish habitat, are detailed in the "Impacts on Eelgrass" section of this chapter. Existing eelgrass habitat would continue to provide prey and cover for Pacific groundfish. DBOC's continued use of the 95 wooden racks, totaling approximately 5 miles (7 acres) within Drakes Estero, would continue to displace natural eelgrass habitat and would provide non-natural structured habitat that would continue to attract prey for fish species such as kelp surfperch.

As described above, alternative D would result in long-term minor adverse impacts on fish for an additional 10 years because while the natural species composition would remain altered due to the presence of non-natural structured habitat, impacts would be localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community.

Upon expiration of the SUP in 2022, DBOC's removal of the shellfish racks from Drakes Estero and the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to benthic fauna in Drakes Estero. Impacts on fish associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact fish within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include coastal watershed restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of past, present, and reasonably foreseeable future actions would be long-term beneficial. The beneficial impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impact of alternative D would result in a long-term beneficial cumulative impact on fish. Alternative D would contribute a noticeable adverse increment to the overall beneficial cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on fish beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative D would result in long-term minor adverse impacts on fish because while the natural species composition would remain altered due to the presence of non-natural structured habitat, impacts would be relatively localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community. The maintenance of shellfish racks would continue to displace approximately 7 acres of natural fish habitat which would otherwise provide increased cover for fish from piscivorous birds and other fish as well as increased prey for larger groundfish, particularly those attributed to Pacific groundfish habitat in the Groundfish Plan. The cumulative impact would be long-term beneficial, and alternative D would contribute a noticeable adverse increment to the beneficial cumulative impact.

With regards to fish, continued operation of DBOC for 10 additional years would not be consistent with relevant law and policy. The continued maintenance of a non-natural community in Drakes Estero does not further the goal of NPS *Management Policies 2006* to preserve and restore natural communities and ecosystems. Perpetuation of non-natural habitat would continue to attract fish communities that would not naturally be found in Drakes Estero. Additionally, this alternative would not be consistent with the goals set forth in the Magnuson-Stevens Fishery Conservation and Management Act because damage to eelgrass designated as essential fish habitat (habitat of particular concern) within the Pacific Fishery Management Council's Groundfish Management Plan would continue.

IMPACTS ON WILDLIFE AND WILDLIFE HABITAT: HARBOR SEALS

LAWS AND POLICIES

The MMPA (16 USC 1361 et seq., 1401–1407, 1538, 4107) establishes a federal responsibility to conserve marine mammals, with management vested in NOAA under the Department of Commerce for cetaceans (whales and dolphins) and pinnipeds (such as seals). This legislation recognizes that marine mammals are resources of great international significance (aesthetic, recreational, and economic), and should be protected and encouraged to develop to the greatest extent feasible with sound policies of resource management. According to the MMPA, the primary management objective for marine mammals should be to maintain the health and stability of the marine ecosystems. The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens, and the importation of marine mammals and marine mammal products into the United States. Under the MMPA, “take” is defined as “harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect.” “Harassment” is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.” Also, specific clauses within the MMPA protect habitat critical to life history stages such as breeding. Under the MMPA, if an activity is determined to be harassment under the above criteria, a specific permit called an Incidental Harassment Authorization may be required.

NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4 et seq.) states, “the National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems.” Directives for maintaining native species include “preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them.” At the forefront of NPS biological resource management philosophy is the goal of preserving the genetic stock of wildlife species naturally occurring within park lands. As stated under section 4.4.1.2: “The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity” (NPS 2006d).

METHODOLOGY

This section summarizes the impacts on Pacific harbor seals from the actions that would potentially occur under each alternative. In consideration of the populations of harbor seals found within the project area as discussed in chapter 3, impacts are evaluated in the context of the type of impact (direct, indirect), the nature of the impact (i.e., type of disturbance to wildlife and wildlife habitat), the quality and amount of harbor seal habitat impacted, and the potential for risks posed by proposed actions (e.g., introduction of nonnative species).

Between spring 2007 and 2010 more than 250,000 digital photographs were taken from remotely deployed cameras overlooking harbor seal haul-out areas in Drakes Estero. The photographs were taken in one minute intervals. Because the collection of these photos was not based on documented protocols and procedures, the body of photographs does not meet the Department's standards for a scientific product. As a result, the photographs have not been relied upon in this EIS. These photographs are posted and available for review on the NPS website at:

http://www.nps.gov/pore/parkmgmt/planning_reading_room_photographs_videos.htm

In July 2009, the MMC initiated a review of the potential effects of human activities, including aquaculture operations, on harbor seals in Drakes Estero. The document is under internal review by the MCC. This report will be reviewed and considered as part of the NEPA process for this EIS when it becomes available.

Intensity Definitions

Minor:	Impacts would be localized and slightly detectable, but would not affect the overall structure of any natural community.
Moderate:	Impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.
Major:	Impacts would be highly noticeable and would substantially influence natural resources, e.g., individuals or groups of species, communities, or natural processes.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The elimination of DBOC boat traffic (up to 12 trips per day, six days per week), especially during harbor seal pupping season (March 1 through June 30), coupled with ongoing restrictions on recreational access during the same time, would likely result in beneficial impacts on harbor seals by reducing human disturbance and displacement effects during important harbor seal reproductive periods (Suryan and Harvey 1999). Becker, Press, and Allen (2011) show harbor seal haul-out areas documented in the Estero, including along the entire lateral channel in the central portion of Drakes Estero. Discontinuing operations would remove bags and boat traffic from this area, allowing for potential expansion of use areas by the seals.

In general, wildlife species can be very sensitive to sound, as animals often depend on auditory cues for hunting, predator awareness, sexual communication, defense of territory, and habitat quality assessment (Barber, Crooks, and Fristrup 2010). Negative behavioral and habitat-use consequences of higher ambient

sound levels from human voices, along with sound events associated with human activities (motorists, hikers), have been observed in many species both at individual and population levels (Frid and Dill 2002; Landon et al. 2003; Habib, Bayne, and Boutin 2007). Human activities can disturb harbor seals at haul-out sites, causing changes in harbor seal abundance, distribution, and behavior, and can even cause abandonment (Suryan and Harvey 1999; Grigg et al. 2002; Seuront and Prinzivalli 2005; Johnson and Acevedo-Gutierrez 2007). Due to the removal of potentially disruptive activities associated with DBOC within Drakes Estero, alternative A would be expected to result in beneficial impacts on harbor seals.

Removal of shellfish infrastructure from within Drakes Estero may require the use of motorboats for a period of up to two months. This disturbance would continue to generate the human-caused noise that currently disrupts harbor seals, but would be conducted outside of the harbor seal pupping season to minimize adverse impacts.

Under alternative A, NPS would install a gate to prevent all boat-related recreational access to Drakes Estero during harbor seal pupping season (March 1- June 30 annually). The placement of a locked gate restricting boat access to Drakes Estero during pupping season would be an effective deterrent, preventing adverse impacts on harbor seals from boat use during pupping season. This restriction on recreational access to Drakes Estero would be expected to have beneficial impacts on harbor seals.

As described above, alternative A would result in long-term beneficial impacts on harbor seals because of the reduced disturbance to seals that would result from the termination of DBOC operations and associated human activities within Drakes Estero. Alternative A may also result in short-term minor adverse impacts because while impacts to harbor seals would continue, the impacts associated with rack removal would be localized and slightly detectable, and would not affect the overall structure of the natural community.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact harbor seals and harbor seal habitat within the project area. These actions include kayaking, planning and management activities, and the CDFG MLPA initiative.

Nonmotorized boats, including kayaks, are known to disrupt hauled-out harbor seals. As such, continued kayaking within Drakes Estero would result in minor adverse impacts on harbor seals. Kayaks would not be allowed into Drakes Estero during the critical pupping season. While harbor seal disturbances could still occur outside of the pupping season, such disturbances are less likely to have population-level effects during that time of year.

Some limited use of motorized boats within Drakes Estero may take place for research or administrative purposes. Any motorboat use for research or administrative is subject to minimum requirement and minimum tool analysis and would be infrequent. The noise generated by these boats would cause impacts on seals similar to those discussed above caused by DBOC motorboats; however, boat use within Drakes Estero would take place in compliance with mitigation measures such as maintaining a 100 yard distance from hauled out seals and not doing work during the pupping season closure. Therefore, the adverse impacts from these activities would be less than minor.

The MLPA prohibits the take of any living marine resource within the Drakes Estero Marine Conservation Area, except recreational clam gathering and commercial shellfish aquaculture. Alternative A, in combination with the MLPA would result in only recreational clamming allowed within the Estero, thus reducing potential disturbance-related impacts. Efforts associated with the MLPA have had and will continue to have a beneficial impact on harbor seals.

Based on the information above, the impact of past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on harbor seals. Alternative A would contribute an appreciable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on harbor seals due to the termination of DBOC operations and associated human activities within Drakes Estero. Disturbance would be limited to recreational kayakers, hikers on the adjacent landscape, and aircraft. The former two would be prohibited (and physically excluded from accessing the kayak launch) during harbor seal pupping season. Based on current research (Becker, Press, and Allen 2011), the termination of shellfish mariculture in Drakes Estero may benefit the distribution and abundance of the native harbor seal population.

Alternative A may also result in short-term minor adverse impacts due to impacts associated with rack removal, which would be localized and slightly detectable, but would not affect the overall structure of any natural community. These activities would be conducted outside of the harbor seal pupping season to minimize adverse impacts. The cumulative impact would be long-term beneficial, and alternative A would contribute an appreciable beneficial increment to the overall cumulative impact.

With respect to harbor seals, alternative A is consistent with relevant law and policy because removal of DBOC operations from Drakes Estero would remove an unnatural stimulus that currently affects harbor seal behavior. Additionally, the decrease in disturbance to this species would be consistent with MMPA (16 USC 1361 et seq., 1401–1407, 1538, 4107).

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact harbor seals include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

DBOC operations would continue to be subject to the harbor seal protection protocol as part of the SUP. This protocol prohibits boat travel and general operations, including placement of bags, moorings, and installation of floating racks, within the established harbor seal protection areas (see figure 3-5). Other

restrictions contained in the existing protocol, such as closure of the lateral channel (also shown on figure 3-5) during the harbor seal pupping season (March 1–June 30) and maintenance of a 100-yard buffer from any hauled-out harbor seal, would continue to be in effect. The removal of mariculture beds from harbor seal protection zones that would occur as a result of changes to the offshore permit boundary under this alternative would be expected to have a beneficial impact on harbor seals.

Under alternative B, the current setback requirement of 100 yards from any hauled out seal (MMPA) would be retained. While the NAS 2009 indicates that larger setbacks are used in Europe, this setback is based, in part, on the MMPA standard, the scale of the Estero, and the ability of DBOC staff to reasonably see and recognize a hauled-out harbor seal. Specific information related to noise distribution within the Estero is evaluated in the “Impacts on Soundscapes” section. DBOC employees would continue to access shellfish mariculture structures within Drakes Estero throughout the year, including during the harbor seal pupping season. DBOC vessels would be required to maintain a 100-yard distance from any hauled-out harbor seals, and would be required to stay out of the harbor seal protection zones depicted on figure 3-3.

The continuation of DBOC activities under alternative B would include the operation of motorboats in the permit area (up to eight hours a day, six days a week, year-round) and the placement and maintenance of bags on sandbars and mudflats adjacent to harbor seal protection areas. These ongoing actions are likely to have adverse impacts on harbor seals (Suryan and Harvey 1999; Becker, Press, and Allen 2011).

During the harbor seal pupping season (March 1 through June 30), DBOC boats are the only boats (motorized or nonmotorized) permitted to be in the Estero. The Estero is closed to all recreational boat access during this time. Under alternative B, the continuation of DBOC motorboat traffic would result in adverse impacts on harbor seals by allowing mariculture-related disturbances to continue during important harbor seal reproductive periods. Long-term research on mariculture activity within Drakes Estero suggests that boat traffic and other actions related to DBOC operations affect how harbor seals use haul out areas near mariculture sites (Becker, Press, and Allen 2011).

The adverse effects of human-induced disturbance to harbor seals have also been observed in other California bays (Grigg et al. 2002), in west coast locales (Suryan and Harvey 1999; Johnson and Acevedo-Gutierrez 2007; Jansen et al. 2006), in the Gulf of Maine (Lelli and Harris 2001), and in Europe (Brasseur and Fedak 2003; Seuront and Prinzivalli 2005). For west coast populations, larger environmental factors such as the El Niño–Southern Oscillation events can affect harbor seal attendance and reproduction at haul-out sites (Trillmich and Ono 1991; NAS 2009). In a recent review of the long-term data at Drakes Estero, Becker, Press, and Allen (2011) used a model-based approach to show that harbor seals preferentially use haul-out sites less when located near active oyster mariculture sites during years of high vs. low oyster harvest. Studies in west coast estuaries suggest that motorized watercraft are a greater threat for harbor seal disturbance relative to other human activities (such as pedestrian tourists, canoeists, or kayakers) (Suryan and Harvey 1999; Calambokidis et al. 1991). Lastly, there may be impacts on harbor seals related to underwater sounds produced by DBOC based on previous research on other marine mammals (NAS 2003).

Alternative B would result in long-term moderate adverse impacts on harbor seals for another 10 years due to displacement effects within Drakes Estero of human activities associated with DBOC's operation

and the potential for disturbances that are known to disrupt harbor seal behavior and displace seals. These impacts would be clearly detectable.

Upon expiration of the SUP in 2022 and the removal of DBOC's commercial operations in Drakes Estero, the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts on harbor seals in Drakes Estero. Impacts on harbor seals associated with the cessation of DBOC operations and the conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact seals within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include kayaking, planning and management activities, and the MLPA as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative B would result in a long-term moderate adverse cumulative impact on harbor seals in the project area. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

Conclusion

Overall, alternative B would result in long-term moderate adverse impacts on harbor seals due to continuation of commercial shellfish operations within Drakes Estero year-round, for another 10 years, and the associated use of motorboats and bottom bag cultivation on sandbars and mudflats adjacent to the designated harbor seal protection areas. This would result in continued human presence and potential harbor seal disturbances throughout the year. Although the mandatory buffer of 100 yards from hauled-out harbor seals (year round) and other restrictions during the harbor seal pupping season would be retained in the SUP issued to DBOC, alternative B would result in moderate adverse impacts on harbor seals due to the potential for displacement and continued disturbances that are known to disrupt harbor seal behavior. The impacts associated with alternative B would be clearly detectable and could appreciably affect harbor seals and harbor seal habitat. The cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to harbor seals, alternative B does not further the goals of relevant law and policy because continued DBOC operations in Drakes Estero would maintain an unnatural stimulus that has the potential to affect harbor seal behavior. NPS *Management Policies 2006* specify that NPS managers should strive to preserve and restore "behaviors of native plant and animal populations and the communities and ecosystems in which they occur" (NPS 2006d). Additionally, the continued disturbance to this species would be subject to regulation by the MMPA (16 USC 1361 et seq., 1401–1407, 1538, 4107). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S.

citizens, and the importation of marine mammals and marine mammal products into the United States. Under the MMPA, “take” is defined as “harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect.” “Harassment” is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.” Under the MMPA, if an activity is defined as harassment under the above criteria, a specific permit called an Incidental Harassment Authorization may be required.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact harbor seals are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC’s racks and bags would occupy the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any difference in impacts.

Impacts associated with DBOC operations and facilities under alternative C would be associated with disturbance of harbor seals year-round by DBOC operations within Drakes Estero and would be expected to be the same those described under alternative B.

Alternative C would result in long-term moderate adverse impacts on harbor seals for another 10 years due to displacement effects and the potential for disturbances that are known to disrupt harbor seal behavior and displace seals. These impacts would be clearly detectable.

Upon expiration of the SUP in 2022 and the removal of DBOC’s commercial operations in Drakes Estero, the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts on harbor seals in Drakes Estero. Impacts on harbor seals associated with the cessation of DBOC operations and the conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact seals within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include kayaking, planning and management activities, and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative C would result in a long-term moderate adverse cumulative impact on

harbor seals and harbor seal habitat in the project area. Alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

Conclusion

Overall, alternative C would result in long-term moderate adverse impacts on harbor seals due to continuation of commercial shellfish operations within Drakes Estero year-round, for another 10 years, and the associated use of motorboats and bottom bag cultivation on sandbars and mudflats adjacent to the designated harbor seal protection areas. This would result in continued human presence and potential harbor seal disturbances throughout the year. Although the mandatory buffer of 100 yards from hauled-out harbor seals (year round) and other restrictions during the harbor seal pupping season would be retained in the SUP issued to DBOC, alternative C would result in moderate adverse impacts on harbor seals due to the potential for displacement and continued disturbances that are known to disrupt harbor seal behavior. The impacts associated with alternative C would be clearly detectable and could appreciably affect harbor seals and harbor seal habitat. The cumulative impact would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to harbor seals, alternative C does not further the goals of relevant law and policy because continued DBOC operations in Drakes Estero would maintain an unnatural stimulus that has the potential to affect harbor seal behavior. NPS *Management Policies 2006* specify that NPS managers should strive to preserve and restore “behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006d). Additionally, the continued disturbance to this species would be subject to regulation by the MMPA (16 USC 1361 et seq., 1401–1407, 1538, 4107). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens, and the importation of marine mammals and marine mammal products into the United States. Under the MMPA, “take” is defined as “harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect.” “Harassment” is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.” Under the MMPA, if an activity is defined as harassment under the above criteria, a specific permit called an Incidental Harassment Authorization may be required.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact harbor seals include:

- Increased production limit

Under alternative D, DBOC would be permitted to produce up to 850,000 pounds of shellfish per year, which is an increase over the production limits of alternative B (600,000 pounds per year) and alternative C (500,000 pounds per year). A production limit of this magnitude would likely require an increase in boat traffic when compared to the other two action alternatives. An increase in motorboat traffic within Drakes Estero has the potential to increase disturbance to harbor seals, although the seal protection protocol mitigation measures discussed earlier would still apply.

As described above, alternative D would result in long-term moderate adverse impacts on harbor seals for another 10 years due to displacement effects and the potential for disturbances that are known to disrupt harbor seal behavior and displace seals. These adverse impacts will be greater than those associated with alternatives B and C due to the likely increase in boat traffic in Drakes Estero, but are still expected to be moderate in intensity and would remain clearly detectable.

Upon expiration of the SUP in 2022 and the removal of DBOC's commercial operations in Drakes Estero, the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts on harbor seals in Drakes Estero. Impacts on harbor seals associated with the cessation of DBOC operations and the conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact seals within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include kayaking, planning and management activities, and the CDFG MLPA initiative as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative D would result in a long-term moderate adverse cumulative impact on harbor seals in the project area. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative D would result in long-term moderate adverse impacts on harbor seals due to continuation of commercial shellfish operations within Drakes Estero year-round, for another 10 years, and the associated use of motorboats and bottom bag cultivation on mudflats adjacent to the designated harbor seal protection areas. This would result in continued human presence and potential harbor seal disturbances throughout the year. Although the mandatory buffer of 100 yards from hauled-out harbor seals (year round) and other restrictions during the harbor seal pupping season would be retained in the SUP issued to DBOC, alternative D would result in moderate adverse impacts on harbor seals due to the potential for displacement and continued disturbances that are known to disrupt harbor seal behavior. The adverse impacts associated with alternative D would be of greater magnitude than those associated with alternatives B and C due to the likely increase in boat traffic in Drakes Estero associated with increased

production levels (approximately 40 percent greater than alternative B and 70 percent greater than alternative C), but are still expected to be moderate in intensity and would be clearly detectable and could appreciably affect harbor seals and harbor seal habitat. The cumulative impact would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to harbor seals, alternative D does not further the goals of relevant law and policy because continued DBOC operations in Drakes Estero would maintain an unnatural stimulus that has the potential to affect harbor seal behavior. NPS *Management Policies 2006* specify that NPS managers should strive to preserve and restore “behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006d). Additionally, the continued disturbance to this species would be subject to regulation by the MMPA (16 USC 1361 et seq., 1401–1407, 1538, 4107). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens, and the importation of marine mammals and marine mammal products into the United States. Under the MMPA, “take” is defined as “harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect.” “Harassment” is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.” Under the MMPA, if an activity is defined as harassment under the above criteria, a specific permit called an Incidental Harassment Authorization may be required.

IMPACTS ON WILDLIFE AND WILDLIFE HABITAT: BIRDS

LAWS AND POLICIES

NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4 et seq.) states, “the National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems.” Directives for maintaining native species include “preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and, minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them.” At the forefront of NPS biological resource management philosophy is the goal of preserving the genetic stock of wildlife species naturally occurring within park lands, as stated under section 4.4.1.2: “The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity” (NPS 2006d).

The MBTA (16 USC 703–712, as amended) makes it illegal, unless permitted by regulations, to “pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird ... or any part, nest, or egg of any

such bird.” Under the MBTA, a “migratory bird” is any species or family of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle.

METHODOLOGY

This section summarizes the impacts on birds from the actions that would potentially occur under each alternative. In consideration of the populations of shorebirds and waterbirds found within the project area as discussed in chapter 3, impacts are evaluated in the context of the type of impact (direct, indirect), the nature of the impact (i.e., type of disturbance to wildlife and wildlife habitat), the quality and amount of bird habitat impacted, and the potential for risks posed by proposed actions.

Intensity Definitions

Minor:	Impacts would be localized and slightly detectable, but would not affect the overall structure of any natural community.
Moderate:	Impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes.
Major:	Impacts would be highly noticeable and would substantially influence natural resources, e.g., individuals or groups of species, communities, or natural processes.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including mariculture infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The termination of DBOC operations and the removal of DBOC facilities and infrastructure would have various impacts on the different types of birds and bird habitat present within Drakes Estero. The 2003 Southern Pacific Shorebird Conservation Plan notes the Drakes Estero and Estero de Limantour system as a site of regional importance to shorebird conservation by the Western Hemisphere Shorebird Reserve Network (Hickey et al. 2003). Further, the North American Waterbird Conservation Plan Waterbird Initiative includes the Seashore as an important bird area (Kushlan et al. 2002).

Drakes Estero is not a significant breeding site for most of the birds found there; rather, it is a major foraging and resting location for many resident (year-round) and nonresident (migratory) birds known to use the project area. This habitat includes intertidal beaches, intertidal flats, brackish marshland, and open subtidal waters, which attract abundant bird populations due to a high abundance of available prey species and protection from predators. Foraging and resting habitat like that found in Drakes Estero is especially critical for migrants. The habitat provides staging sites for migrants needing to restore energy after long periods of migration, and foraging and resting habitat for species that overwinter during their non-

breeding season. Examples of migrant species that can overwinter in Drake Estero and the Seashore include brown pelicans, American white pelicans, buffleheads, ruddy ducks, western sandpipers, and marbled godwits (Evens 2008).

Under alternative A, the termination of DBOC mariculture activities in Drakes Estero would remove the DBOC mariculture structures and operations that often coincide with the foraging and resting habitat for birds, especially mud flats, sand flats, and intertidal beaches. This would have beneficial effects on bird populations in Drakes Estero, as studies show that commercial oyster operation staff can disrupt normal biological activities of birds, such as foraging (Kelly et al. 1996), which can result in reduced fitness due to the energy expended in flight (NAS 2009).

Noise associated with DBOC motorboats can frequently cause birds to flush (i.e., abruptly fly away) and interrupt normal biological activity. In general, wildlife species can be very sensitive to sound, as animals often depend on auditory cues for hunting, predator awareness, sexual communication, defense of territory, and habitat quality assessment (Barber, Crooks, and Fristrup 2010). The negative associations of behavioral and habitat-use consequences of higher ambient sound levels from human voices, along with sound events associated with human activities (motorists, hikers), have been observed in many species both at individual and population levels (Frid and Dill 2002; Landon et al. 2003; Habib, Bayne, and Boutin 2007). The removal of DBOC boats and other activities would minimize the potential for flushing and disruption of normal biological activities such as foraging and resting (see discussion under alternative B) and would therefore result in beneficial impacts to birds.

The removal of mariculture bags from mudflats and sand flats in Drakes Estero would also have beneficial impacts to birds that feed on benthic invertebrates. DBOC bottom cultivation methods including bags and trays would potentially cover up to 88 acres of intertidal (approximately 22 acres of bags were planted in each of the last two years according to DBOC proof-of-use reports) substrate and may prevent some birds from foraging for prey species that live in the underlying substrate. By terminating bottom bag cultivation in Drakes Estero, foraging birds would no longer be prevented from accessing the sediments directly underneath bags (NAS 2009). This change would result in beneficial impacts by improving available foraging and resting habitat for birds (see discussion under alternative B). Additionally, removal of oyster racks (95 racks equaling approximately 5 linear miles or 7 acres) would likely allow the natural eelgrass habitat to regenerate, providing additional benefits to birds that use eelgrass bed specifically for foraging (e.g., black brant). While birds that feed on prey on top of cultivation bags may experience a loss in foraging habitat (NAS 2009), there is no evidence the cultivation bags provide the only foraging opportunity for these bird species and therefore adverse impacts resulting from removal of the bags are not expected.

Removal of shellfish infrastructure from within Drakes Estero may require the use of motorboats for a period of up to two months. This disturbance would continue to generate the human-caused noise that currently disrupts birds.

As described above, alternative A would result in long-term beneficial impacts on birds due to the reduced disturbance to normal biological behavior and improved habitat quality associated with the termination of DBOC operations and associated human activities within Drakes Estero. Alternative A may also result in short-term minor adverse impacts on birds because impacts related to rack removal would occur but would be highly localized and would not affect the overall structure of any natural community.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact birds and bird habitat within the project area. These actions include restoration of the developed onshore area following SUP expiration, kayaking, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative.

Restoration of the developed onshore area following SUP expiration would restore wetlands and nearshore habitats, which are frequented by birds using Drakes Estero for activities such as foraging for food and resting. These restoration activities would result in long-term beneficial impacts on birds and bird habitat. Recent coastal watershed restoration efforts within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) included the enhancement of habitat for organisms upon which birds feed, such as native benthic invertebrates or eelgrass. As such, these projects may have resulted in beneficial impacts on birds and bird habitat within the project area.

Restoration of the developed onshore area following SUP expiration would include wetlands restoration practices that would, in turn, improve bird habitat areas, affecting approximately 5 acres. Intertidal wetlands represent potential foraging habitat for some birds that live in Drakes Estero. These restoration efforts would result in long-term beneficial impacts on birds.

Nonmotorized boats, including kayaks, are known to cause birds to flush. Continued kayaking within Drakes Estero would result in minor adverse impacts on birds. Additionally, planning and management activities may authorize use of motorized boats within Drakes Estero for research or administrative purposes. The noise generated by these boats would cause impacts on birds similar to those caused by DBOC motorboats and discussed under Alternative B; however, this motorboat use is subject to minimum requirement and minimum tool analysis, would be highly infrequent, and timing and location of access could be limited. Therefore, the adverse impacts from these activities would be less than minor.

The MLPA prohibits the take of any living marine resource within a marine protection area, except recreational clam gathering and commercial shellfish aquaculture. Alternative A, in combination with the MLPA would result in only recreational clamming allowed within the Estero. Since birds can feed on marine organisms, efforts associated with the MLPA have had and will continue to have a beneficial impact on birds and bird habitat.

Based on the information above, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on birds and bird habitat. Alternative A would contribute an appreciable beneficial increment to the cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on birds due to the removal of the commercial shellfish operation within Drakes Estero and its associated human activities. Removal of

DBOC motorboats and related activities would minimize the disruption of biological activities such as foraging and resting. Intertidal areas previously used by DBOC for the bottom bag cultivation in commercial operations would result in up to 88 additional acres of foraging and resting habitat for resident and migratory birds. Alternative A may result in adverse impacts to birds from rack removal, but the impacts would be short-term and minor because they would be highly localized and would not affect the overall structure of any natural community. Cumulative impacts would be long-term beneficial and alternative A would contribute an appreciable beneficial increment to the overall cumulative impacts.

Alternative A would be consistent with the goals set forth in both NPS *Management Policies 2006* and the MBTA. NPS *Management Policies 2006* specify that NPS managers should strive to preserve and restore “behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006d). The MBTA (16 USC 703–712, as amended) makes it illegal for people to “take” migratory birds, their eggs, feathers or nests.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact birds include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

While the multitude of bird species, populations, and habitats across the Seashore are well documented, data reflecting mariculture impacts on birds in Drakes Estero are limited. In their concluding statements on the effects of bivalve mariculture on birds in Drakes Estero, NAS (2009) provides the following:

No study has been conducted to test the impacts of mariculture on birds of Drakes Estero. Drakes Estero represents an important site for overwintering and seasonally migrating shorebirds and waterfowl, with special significance as a feeding and staging site for migrating black brant geese. Boat travel by the mariculturists is likely to disturb and flush seaducks, shorebirds, and other waterbirds. Furthermore, the presence of lines of oyster bags on the intertidal flats is likely to diminish the feeding area for some probing shorebirds, while enhancing food supplies for other shorebirds willing to consume epibiotic amphipods and other invertebrates associated with algal growth on mariculture bags.

DBOC motorboats make multiple trips each day (up to 12 40-minute trips per day, amounting to approximately 1,500 trips per year) to destinations throughout the project area (DBOC [Lunny], pers. comm., 2011h). For comparative purposes, the estimated noise produced from these boat motors at a distance of 50 feet is equivalent to a household vacuum cleaner at roughly 10 feet (about 70 dBA; see soundscapes in chapter 3). Detail related to soundscapes is provided in the “Impacts on Soundscapes” section of this chapter. Birds rely heavily on auditory cues during biological activities and detection of predator alerts or warning signals, which makes them especially susceptible to various human-associated

environmental sounds (Francis, Ortega, and Cruz 2009). Waterbirds are most susceptible to disturbance from human activities during nesting, foraging, and resting. In addition, in areas of high disturbance from motorboats and other watercraft, repeated flushing of waterbirds can lead to avoidance of normal foraging and resting locations (Rodgers and Schwikert 2002). Either from their physical presence or more commonly from sounds produced by motors and wakes, boats used by DBOC can disturb birds by causing them to flush from essential habitat components, interrupting critical behavior (Kelly et al. 1996). This disruption of biological activities such as foraging and resting can result in reduced fitness due to the energy expended in flight (NAS 2009).

Similarly, other sounds from DBOC activity include noise produced from generators and pneumatic equipment, which concentrate in Schooner Bay and have adverse effects on foraging and resting birds nearby. Similar to the physical degradation of habitat caused by development or other human activities, the low-frequency, high-amplitude, nearly omnipresent sound produced by roads, vehicles, airports, and mechanical equipment has been found to result in a decline in species diversity, abundance, and breeding success (Rheindt 2003). Pneumatic drills and oyster tumblers are used by DBOC staff for approximately 2 hours per day near the dock. The estimated noise from this equipment at a distance of 50 feet is comparable to a noisy urban area during the day, or a diesel truck at roughly 50 feet (80-85 dBA; see soundscapes in chapter 3). The diversity of bird species and the population of many bird species decrease in locations closer to a road or other sources of mechanized sound, which is described as the “road effect” (Francis, Ortega, and Cruz 2009). This effect is often attributed to mechanical noise levels rather than to decreased habitat quality or direct mortality caused by vehicle collisions (Reijnen et al. 1995; Rheindt 2003). Within Drakes Estero, road effects could occur in Schooner Bay and other areas adjacent to frequent boat traffic. Bird response to road effects and disruption of normal behavior could reduce overall fitness required to successfully reach migratory breeding habitat and breed successfully upon arrival.

In areas with a high frequency of low-level noises, like the human-caused sounds within Drakes Estero, certain species can suffer more negative effects than others. Researchers have found this is due, in part, to greater differences between bird song frequency and the low-frequency sound produced by motorized vehicles. That is, birds with higher-frequency songs (like some songbirds) may have greater density near high-frequency, low-level noises than those with songs in lower frequencies (Rheindt 2003). High-frequency songs are not as strongly masked by the low-frequency sounds and can be perceived more clearly by the receiving birds, thus increasing potential for communication. Shorebirds and waterbirds generally use less complex sounds to communicate than songbirds. When compared with songbirds, many shorebirds have a decreased range of song selection and frequency and use mainly lower-pitched calls (Douglas and Conner 1999). This may limit the ability for shorebirds to adjust their vocalizations, and increase the potential for their songs to be masked in the presence of low-frequency sounds. Therefore, due to a potentially reduced capacity to communicate and carry out normal biological activities, the shorebirds and waterbirds within Drakes Estero with lower-frequency and/or lower-amplitude calls may be more adversely affected by road effects from DBOC motorboats and operations.

In addition, predation risk for many birds increases in areas with high-amplitude, low-frequency mechanical sounds (Lima 2009), such as DBOC motorboats and pneumatic equipment discussed above. Direct predator risk may increase because birds are unable to detect auditory cues made by the predators (such as a red-tailed hawk scream or the cawing of a crow), and/or because they are unable to detect the warning calls of members of their own species or other birds in the area (e.g., the warning calls of a tern due to a circling hawk). These effects are due to masking or distortion of the natural sounds in the

environment due to the addition of louder mechanical or human-associated sounds. Exposure to frequent sound events, including motorboat use, could also increase the intensity of birds' responses to all perceived predation threats (Rabin, Goss, and Owings 2006). Birds in Drakes Estero may avoid such habitat, thus reducing the availability of habitat containing the best cover and food sources.

In addition to noise-related disturbance, bird populations in Drakes Estero can be affected by the mariculture structures and materials used in DBOC operations. Depending on DBOC production levels, DBOC bottom culture methods, including bags and trays, can cover up to approximately 84 acres of intertidal substrate, preventing some birds from foraging for prey species that live in the underlying substrate. In a review of shellfish mariculture effects in Drakes Estero, NAS (2009) notes that oyster bags placed on intertidal flats prevent probing shorebirds (i.e., birds with long bills used to forage on benthic infauna) from accessing benthic prey species within sediments beneath the bags.

Probing shorebirds are of the most dominant bird species found in Drakes Estero, as evidenced by winter counts conducted from November 1998 to March 1999, in which three of the five most abundant species recorded (dunlins, western sandpipers, and least sandpipers) were probing shorebirds (Page and White 1999). Other less common bird species, such as black-bellied plovers (*Pluvialis squatarola*) and marbled godwits (*Limosa fedoa*) (Page and White 1999), have been observed to forage on top of the bags used in DBOC bottom culture methods (Press 2005). These species are attracted to prey species found on top and within cultivation bags, which can improve foraging success (Press 2005). NAS (2009) states that only obligate probers (i.e. birds that forage primarily by probing) are likely to experience negative affects by mariculture on intertidal flats in Drakes Estero (NAS 2009). Therefore, due to the abundance of probing shorebirds that forage on benthic prey covered by mariculture bags, DBOC's use of up to 84 acres of intertidal areas for bottom bag culture would be expected to have an adverse effect on the bird population and foraging habitat in Drakes Estero. While birds that feed on prey on top of bags may experience foraging habitat benefits (NAS 2009), there is no evidence that prey on the bags provide the only foraging opportunity for these bird species.

Other DBOC structures that affect bird populations in Drakes Estero are the oyster racks. As described in the "Impacts on Eelgrass section," displacement of eelgrass habitat by the 95 wooden racks totals approximately 5 miles (7 acres) within Drakes Estero. This reduction in eelgrass consequently reduces the primary food source for black brant (NAS 2009), which use estuaries vegetated with eelgrass as staging areas during migration, and regularly overwinter in Drakes Estero (Evens 2008). Since brant forage on eelgrass they can temporarily disturb eelgrass beds, but in turn also contribute to eelgrass detritus (NAS 2009). DBOC oyster racks also limit access of birds that forage in the water column, and can alter prey species diversity (attracting more structure oriented species) for birds that forage in eelgrass beds. See "Impacts on Wildlife and Wildlife Habitat: Fish" and "Impacts on Eelgrass" for additional detail on these topics. Further, while DBOC oyster racks can provide roosts that serve as resting habitat, the interruption from DBOC motorboats and staff likely negates any energy storage or fitness benefits.

As concluded in the "Impacts to Eelgrass" section, damage from DBOC motorboats has been estimated to have affected roughly 8.5 miles of propeller scars when viewed aerially from 2010 photographs. It is anticipated that regardless of the regrowth and recovery rates of eelgrass in the Estero, the amount of scarring under alternative B would remain similar to that observed in the 2010 aerial photographs. Other than black brant, which use eelgrass habitat directly as a food source, other birds forage within the beds themselves for prey species such as crustaceans and invertebrates. Damage to the eelgrass habitat indirectly

changes the natural structural composition of the benthic habitat. This damage and resulting change to natural habitat elements can affect the natural composition of species which reside in the habitat. This would be expected to have adverse impacts on bird populations that forage in eelgrass habitats.

As described above, alternative B would result in long-term moderate adverse impacts on birds and bird habitat for an additional 10 years because noise disturbances from DBOC motorboats and the displacement of natural habitat by shellfish racks and bags within Drakes Estero would be clearly detectable and could appreciably affect natural processes.

Upon expiration of the SUP in 2022 and the removal of DBOC's commercial operations in Drakes Estero, the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts on birds in Drakes Estero. Impacts on birds associated with the cessation of DBOC operations and the conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impacts birds and bird habitat within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include kayaking, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative B, would result in a long-term moderate adverse cumulative impact on birds and bird habitat. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on birds and bird habitat beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Alternative B would result in long-term moderate adverse impacts on birds and bird habitat due to the continuation of commercial shellfish operations and the associated human activities within Drakes Estero for an additional 10 years. Continued use of motorboats and other noise-producing equipment, as well as maintenance of shellfish growing structures, within Drakes Estero would continue to disrupt biological activity of birds, such as foraging and resting behavior, potentially leading to a reduction in fitness and reproductive success. Noise disturbance from DBOC operations would also alter other biological activities of birds using Drakes Estero, such as predator avoidance. The impacts of alternative B would be clearly detectable and could appreciably affect birds and bird habitat within the project area. The

cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the overall impact.

With respect to birds, alternative B would not be consistent with the goals set forth in the NPS *Management Policies 2006*, which specifies that NPS managers should strive to preserve and restore “behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006d). No actions are anticipated to be inconsistent with the MBTA (16 U.S.C. 703–712, as amended), which makes it illegal to “take” migratory birds, their eggs, feathers or nests.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact birds are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC’s racks and bags would occupy the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any difference in impacts.

Impacts associated with DBOC operations and facilities under alternative C would be associated with disturbance of birds by DBOC operations within Drakes Estero and the displacement of habitat associated with continued use of racks and bags for shellfish cultivation. These impacts would be expected to be the same those described under alternative B.

As described under alternative B, alternative C would result in long-term moderate adverse impacts on birds and bird habitat for an additional 10 years because noise disturbances from DBOC motorboats and the displacement of natural habitat by shellfish racks and bags within Drakes Estero would be clearly detectable and could appreciably affect natural processes.

Upon expiration of the SUP in 2022 and the removal of DBOC’s commercial operations in Drakes Estero, the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts on birds in Drakes Estero. Impacts on birds associated with the cessation of DBOC operations and the conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impacts birds and bird habitat within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include kayaking, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative, as described under alternative A. For the same

reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative C, would result in a long-term moderate adverse cumulative impact on birds and bird habitat. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on birds and bird habitat beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Alternative C would result in long-term moderate adverse impacts on birds and bird habitat due to the continuation of commercial shellfish operations within Drakes Estero for an additional 10 years and the associated human activities. Continued use of motorboats and other noise-producing equipment, as well as maintenance of shellfish growing structures, within Drakes Estero would continue to disrupt biological activity of birds, such as foraging and resting behavior, potentially leading to a reduction in fitness and reproductive success. Noise disturbance from DBOC operations would also alter other biological activities of birds using Drakes Estero, such as predator avoidance. The impacts of alternative C would be clearly detectable and could appreciably affect birds and bird habitat within the project area. The cumulative impact would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

With respect to birds, alternative C would not be consistent with the goals set forth in the NPS *Management Policies 2006*, which specifies that NPS managers should strive to preserve and restore “behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006d). No actions are anticipated to be inconsistent with the MBTA (16 U.S.C. 703–712, as amended), which makes it illegal to “take” migratory birds, their eggs, feathers or nests.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact birds and bird habitat include:

- Production limit of 850,000 pounds of shellfish per year

The increase in production would likely lead to additional use of DBOC motorboats in Drakes Estero and an increase in the use of bottom bag culture. This potential increase in DBOC activity may result in impacts greater than those expected under alternatives B and C, although the degree of difference is unable to be determined. Additional motorboat disturbance to birds and bird habitat would likely be

attributed to potential increases in noise and damage to eelgrass in Drakes Estero. Bottom bags and oyster racks used by DBOC would continue to degrade the foraging habitat for other birds. Other aspects of alternative D, including NPS operations and facilities, would be expected to have the same impacts as those described in alternative B.

As described in alternative B, alternative D would result in long-term moderate adverse impacts on birds and bird habitat for an additional 10 years because noise disturbances from DBOC motorboats and the displacement of natural habitat by shellfish racks and bags within Drakes Estero would be clearly detectable and could appreciably affect natural processes. These adverse impacts would be greater than those associated with alternatives B and C due to the likely increase in DBOC boat traffic in Drakes Estero, but are still expected to be moderate in intensity and would remain clearly detectable.

Upon expiration of the SUP in 2022 and the removal of DBOC's commercial operations in Drakes Estero, the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts on birds in Drakes Estero. Impacts on birds associated with the cessation of DBOC operations and the conversion of the site to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impacts birds and bird habitat within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include kayaking, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative, as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative D, would result in a long-term moderate adverse cumulative impact on birds and bird habitat. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on birds and bird habitat beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Alternative D would result in long-term moderate adverse impacts on birds and bird habitat due to the continuation of commercial shellfish operations within Drakes Estero for an additional 10 years and the associated human activities. Continued use of motorboats and other noise-producing equipment, as well as maintenance of shellfish growing structures, within Drakes Estero would continue to disrupt biological activity of birds, such as foraging and resting behavior, potentially leading to a reduction in fitness and reproductive success. Noise disturbance from DBOC operations would also alter other biological

activities of birds using Drakes Estero, such as predator avoidance. These adverse impacts would be greater than those associated with alternatives B and C due to the likely increase in DBOC boat traffic in Drakes Estero associated with increased production (approximately 40 percent greater than alternative B and 70 percent greater than alternative C), but are still expected to be moderate in intensity, would remain clearly detectable and could appreciably affect birds and bird habitat within the project area. The cumulative impact would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the overall impact.

With respect to birds, alternative D would not be consistent with the goals set forth in the NPS *Management Policies 2006*, which specifies that NPS managers should strive to preserve and restore “behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006d). No actions are anticipated to be inconsistent with the MBTA (16 U.S.C. 703–712, as amended), which makes it illegal for people to “take” migratory birds, their eggs, feathers or nests.

IMPACTS ON SPECIAL-STATUS SPECIES

LAWS AND POLICIES

The ESA mandates all federal agencies to consider the potential impacts of their actions on listed threatened or endangered species to protect the species and preserve their habitats. Specifically, section 7 of the ESA states that federal agencies must use their authority to conserve listed species and ensure that their actions do not jeopardize the continued existence of the listed species. In addition, section 6 of the ESA encourages each state to develop and maintain conservation programs for resident federally listed threatened and endangered species. The California Endangered Species Act fulfills section 6 of the federal ESA, and generally parallels the main provisions of the ESA. The USFWS and NMFS share responsibility for implementing the ESA, while CDFG administers the California Endangered Species Act in cooperation with the federal ESA authorities.

NPS *Management Policies 2006*, which currently sets the policy framework for NPS management of federally threatened and endangered species, states that the NPS will “survey for, protect, and strive to recover all species native to national park service units that are listed under the Endangered Species Act” (NPS 2006d). If the NPS determines that an action may adversely impact a federally listed species, consultation with USFWS and/or NMFS would be completed prior to the release of the final EIS to ensure that the action would not jeopardize the species’ continued existence or result in destruction or adverse modification of critical habitat.

METHODOLOGY

The USFWS was contacted for a list of threatened and endangered species and designated critical habitats that may be within the project area. Information on possible threatened or endangered species, candidate species, and species of special concern was also gathered by the NPS from past studies and plans. As stated in chapter 3, NPS determined that no federally listed plant and seven federally listed animal species exist within the project area. This section summarizes the impacts on federally listed animal species or their designated critical habitat from the actions that would potentially occur under each alternative.

These species include Myrtle's silverspot butterfly, central California Coho salmon, central California steelhead, California red-legged frog, leatherback sea turtle, western snowy plover, and California least tern. In the case that animal species are not known to use the designated critical habitat within the project area, the discussion is focused on potential impacts on that habitat (not the animal).

In consideration of the variety of species and associated habitat area discussed in chapter 3, impacts on federally listed animal species are evaluated in the context of the type of impact (direct or indirect), the nature of the impact (i.e., type of disturbance), and the quality and quantity of habitat impacted. This section evaluates both short-term and long-term direct and indirect impacts based on the following:

Intensity Definitions

Minor:	The action could result in a change to a population or individuals of a species or designated critical habitat.
Moderate:	The action would result in some change to a population or individuals of a species or designated critical habitat.
Major:	The action would result in a noticeable change to a population or individuals of a species or designated critical habitat.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972). Based on information provided in the chapter 3, the federally listed animal species considered under this EIS and their potential impacts under alternative A are discussed below.

Myrtle's Silverspot Butterfly. Myrtle's silverspot butterfly inhabits coastal dunes, coastal prairie, and coastal scrub at elevations from sea level to 1,000 feet above sea level, and as far as 3 miles inland (Launer et al. 1992). The coastal scrub community that borders Drakes Estero is included in the range of potential habitat used by the Myrtle's silverspot butterfly populations near Drakes Estero. However, the offshore portion of the project area is largely characterized by intertidal and subtidal wetlands that are not suitable habitat for the silverspot butterfly. While butterflies could potentially fly over Drakes Estero when traveling between habitats, changes in Drakes Estero under alternative A would not likely have an effect on the invertebrate's flight patterns; therefore, alternative A would not be expected to have an impact on the Myrtle's silverspot butterfly or its habitat.

The access road within the onshore portion of the project area is built within the existing coastal scrub communities surrounding Drakes Estero. Under the no-action alternative, the NPS would gate the access road during the harbor seal pupping season (March 1 to June 30). Except for occasional administrative access, there would be no vehicular use of the road during this period. The flight season for the adult

Myrtle's silverspot butterfly in Seashore populations lasts approximately two to three months, starting as early as June and ending as late as September (Launer et al. 1992). The largest numbers of butterflies have been generally observed in July and August (Launer et al. 1992). Therefore, access restrictions to Drakes Estero during the harbor seal pupping season under alternative A could decrease the potential for incidental butterfly mortality resulting from vehicle strikes during the month of June. The removal of DBOC operations from onshore portions of the project area under alternative A would result in less vehicular use of the access road connecting to Sir Francis Drake Boulevard. This change could result in reduced incidental mortality of butterflies from vehicle strikes.

In addition, DBOC would be required to remove its personal property and several structures (e.g., mobile homes) from the area under alternative A. This would allow the land beneath these structures to revegetate naturally. If the revegetated areas established additional coastal scrub communities, this could increase potential feeding and shelter habitat for the Myrtle's silverspot butterfly. During DBOC close out procedures, however, there would be an increase in traffic along the access road, as property and debris are removed from the site. This may cause a temporary increase in risk of vehicle strikes. This close out process is likely to take place outside the seasonal seal closure and last up to two months.

Overall, the actions within the onshore project area under alternative A would result in long-term beneficial impacts on the Myrtle's silverspot butterfly. Alternative A may also result in short-term minor adverse impacts to individual Myrtle's silverspot butterflies because there is a risk for butterfly mortality during increased traffic along the access road during close out procedures.

California Red-legged Frog Critical Habitat. A primary threat to the California red-legged frog is degradation of habitat (USFWS 2002b). The frog requires a variety of habitats, including aquatic breeding areas as well as riparian and upland habitats (nonbreeding) used for dispersal between breeding areas. Aquatic habitats used for breeding include pools and backwaters within streams and creeks, ponds, marshes, springs, sag ponds, dune ponds, and lagoons. California red-legged frogs also breed in artificial impoundments, such as stock ponds (USFWS 2002b). The offshore portion of the project area is largely characterized by intertidal and subtidal habitats that do not constitute suitable aquatic breeding habitat for the California red-legged frog; therefore, offshore activities under alternative A related to removal of racks and bags would not be expected to have an impact on the California red-legged frog.

However, since the red-legged frog disperses long distances over land between breeding habitats, the change in land use of the onshore project area associated with this aspect of alternative A could potentially improve nonbreeding, dispersal habitat. In addition, since designated critical habitat for the California red-legged frog includes the onshore portion of the project area, critical habitat would also be improved. Because the land beneath structures removed would be allowed to revegetate naturally, the resulting vegetation communities could be used by the frog for nonbreeding (riparian and upland) habitat. This would provide benefits to the frog during its movement between breeding habitat by increasing opportunities for feeding, resting, and other essential behavior.

Another threat facing the California red-legged frog is mortality from being run over by vehicles on roads (USFWS 2002b). The removal of DBOC operations from onshore portions of the project area under alternative A would result in less vehicular use of the access road connecting to Sir Francis Drake Boulevard. This change could result in reduced incidental mortality of red-legged frogs from vehicle strikes. During DBOC close out procedures, however, there would be an increase in traffic along the

access road, as property and debris are removed from the site. This may cause a temporary increase in risk of vehicle strikes. This close out process is expected to last up to two months.

Overall, due to the potential improvement of nonbreeding habitat and reduced mortality, alternative A would result in long-term beneficial impacts on California red-legged frog and its critical habitat. Alternative A may also result in short-term minor adverse impacts on California red-legged frogs because there is a risk for increased mortality from increased traffic along the access road during close out procedures.

Central California Coho Salmon Critical Habitat. As an anadromous fish species, Coho salmon migrate from spawning habitat in freshwater streams to ocean habitats, traveling through (and feeding within) estuaries during their migration. While Coho salmon are not currently found in the Drakes Estero watershed, the watershed is included in the critical habitat designation because it has habitat elements required by the Coho salmon. The critical habitat designation considers the following requirements of the species: (1) Space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) Cover or shelter; (4) Sites for breeding, reproduction, rearing of offspring; and (5) Habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species (NOAA 1999).

Human activity within critical habitat areas can cause degradation of the habitat quality and may limit the salmon's potential use of the habitat. For example, scarring of eelgrass beds from motorboats can adversely impact eelgrass beds, which can be an essential component to the salmon's critical habitat in estuaries. Therefore, alternative A would improve the quality of Coho salmon critical habitat by eliminating DBOC motorboat travel, which destroys or degrades eelgrass (see the "Impacts on Eelgrass" section for additional detail). As mentioned under the discussion of impacts on eelgrass, removal of the racks from within Drakes Estero during DBOC closeout procedures may cause temporary adverse impacts due to disturbance of the Drakes Estero bottom during removal of approximately 4,700 posts, which currently support DBOC's 5 linear miles of racks, but would improve the overall quality of eelgrass habitat.

Overall, actions under alternative A would result in long-term beneficial impacts on central California Coho salmon critical habitat as a result of improving designated critical habitat by eliminating impacts on eelgrass caused by DBOC boats. Alternative A may result in short-term minor adverse impacts on central California Coho salmon critical habitat because of localized sedimentation during close out procedures.

Central California Steelhead. Similar to Coho salmon, the central California steelhead is an anadromous fish species that migrates between freshwater spawning habitat and ocean habitat. Unlike the Coho salmon, steelhead are known to occur in the Drakes Estero watershed, and passage through Drakes Estero may occur periodically. During migration, estuaries are used by the steelhead as feeding habitat due to essential habitat elements. For instance, eelgrass beds provide complex habitat elements within the estuarine food web and provide steelhead with feeding opportunities and shelter from predators (PFMC 2003). Destruction of eelgrass in Drakes Estero from human activity, like motorboat travel, reduces habitat availability for the steelhead. As mentioned above, removal of the racks from within Drakes Estero during DBOC closeout procedures may cause additional temporary adverse impacts due to disturbance of the Drakes Estero bottom during removal of approximately 4,700 posts, which currently support DBOC's 5 linear miles of racks, but would improve the overall quality of eelgrass habitat.

Overall, as a result of removing motorboats that damage essential eelgrass habitat in Drakes Estero, the actions under alternative A within the offshore portion of the project area would result in long-term beneficial impacts on the central California steelhead. Alternative A may result in short-term minor adverse impacts on central California steelhead salmon because of localized sedimentation within habitat during close out procedures.

Leatherback Sea Turtle Critical Habitat. Due to the lack of appropriate nesting, migration, and foraging habitat in the project area, alternative A would not be expected to impact the biological activities of the leatherback sea turtle. Nesting habitat is found on sandy beaches in tropical and subtropical climates. Migration occurs within open oceans and seas of pelagic environments. Foraging habitat can coincide with migration habitat or extend into adjacent open ocean waters, including nearshore environments, depending on fluctuations in suitable prey species location and abundance. Suitable prey species are also pelagic, consisting primarily of gelatinous zooplankton (i.e., jellyfish) species and to a lesser extent tunicate species (NMFS 2010a). Pelagic jellyfish do not typically inhabit Drakes Estero, and the *Didemnum* tunicates present in Drakes Estero are not pelagic species. These factors suggest a low likelihood for Drakes Estero to be used by leatherback sea turtles, and impacts to individuals are not expected.

Portions of the project area are included in the proposed revision to leatherback sea turtle critical habitat submitted by NMFS in 2010. The proposed revision includes the marine environments encompassing the Seashore and extends landward to the lower low mean water line, which includes most of Drakes Estero. Because a critical habitat designation includes habitats that are considered essential to the conservation of a federally listed species, human activity within critical habitat areas can cause degradation of essential habitat's quality (see the "Impacts on Eelgrass" section for additional detail). As mentioned under the discussion of impacts on eelgrass, removal of the racks from within Drakes Estero during DBOC closeout procedures, may cause additional temporary adverse impacts due to disturbance of the Drakes Estero bottom during removal of approximately 4,700 posts, which currently support DBOC's 5 linear miles of racks, but would improve the overall quality of eelgrass habitat.

Overall, alternative A could result in long-term beneficial impacts on the leatherback sea turtle as a result of cessation of commercial shellfish operations in Drakes Estero, which serves as proposed critical habitat for the leatherback sea turtle. Alternative A may also result in short-term minor adverse impacts on leatherback sea turtle critical habitat because of localized sedimentation for up to two months.

Western Snowy Plover. Due to the lack of appropriate nesting habitat in the project area, alternative A would not be expected to impact nesting behavior of the western snowy plover. However, the plover is a migratory shorebird and is known to overwinter along the California coast. During migration and overwintering, plovers can use non-nesting habitat such as estuarine sand flats and mudflats for foraging and other biological activities (USFWS 2007). Drakes Estero presents a suitable staging location for migratory birds, as well as suitable foraging habitat to sustain overwintering populations. While the western snowy plover has not been observed foraging in the project area, the plover does nest south of the project area along Limantour Spit, located at the mouth of Drakes Estero.

These factors suggest the potential for Drakes Estero to be used by western snowy plovers for non-nesting (foraging) habitat during migration or overwintering periods. Disruptive human activity (such as motorboats) in Drakes Estero could limit or interrupt opportunities for the plover to forage successfully and result in detriments to successful migration and overwintering. In addition, removal of oyster culture

bags would provide the tern with improved potential foraging habitat. The removal of DBOC operations from Drakes Estero under alternative A could improve the potential for the plover to use offshore portions of the project area for foraging habitat. Removal of shellfish infrastructure from within Drakes Estero may require the use of motorboats for a period of up to two months. This disturbance would temporarily continue to generate human-caused noise that may disrupt birds.

Overall, as a result of potential to improve plover foraging habitat, alternative A would result in long-term beneficial impacts on the western snowy plover. Alternative A may result in short-term minor adverse impacts on western snowy plover because impacts related to rack removal has the potential to disrupt individual birds.

California Least Tern. Similar to the plover, due to lack of appropriate nesting habitat in the project area, alternative A would not be expected to impact the nesting behavior of the California least tern. However, like the plover, the tern is a migratory shorebird and is known to overwinter along the California coast. During migration and overwintering, terns can use non-nesting habitat for foraging and other biological activities. The tern forages primarily in nearshore ocean waters and in shallow estuaries and lagoons (Massey 1977). Drakes Estero is a suitable staging location for migratory birds, allowing birds to rest, forage, and reenergize for continued and successful migration (Evens 2008). Drakes Estero also provides suitable foraging habitat to sustain overwintering populations of many migratory birds (Evens 2008). While the least tern has not been observed foraging in Drakes Estero, nests are known to occur along portions of the San Francisco Bay, located approximately 25 miles east of Drakes Estero.

These factors suggest the potential for Drakes Estero to be used by the California least tern for non-nesting habitat during migration or overwintering periods. As described for the western snowy plover, disruptive human activity (such as motorboats) in Drakes Estero could limit or interrupt opportunities for the tern to forage successfully and result in detriments to successful migration and overwintering. In addition, removal of oyster culture bags would provide the tern with improved potential foraging habitat. The removal of DBOC operations from Drakes Estero under alternative A could improve the potential for the plover to use offshore portions of the project area for foraging habitat. Removal of shellfish infrastructure from within Drakes Estero may require the use of motorboats for a period of up to two months. This disturbance would temporarily continue to generate human-caused noise that may disrupt birds. Overall, as a result of potential to improve foraging habitat, alternative A would be expected to result in long-term beneficial impacts on the California least tern. Alternative A may result in short-term minor adverse impacts on California least tern because impacts related to rack removal has the potential to disrupt individual birds.

Alternative A Summary. Based on the information provided above, overall, alternative A would result in long-term beneficial impacts on special-status species within the project area. Alternative A may also result in short-term minor adverse impacts to special-status species during removal of DBOC facilities and personal property because removal could disturb individuals or cause temporary sedimentation within designated critical habitat. However, the short-term impacts related to removal would be highly localized and would last up to two months.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact special-status species within the project area. These actions include restoration of the developed onshore area following SUP expiration, kayaking, monitoring/managing invasive species, management of red-legged frog ponds, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative.

Restoration of the developed onshore area following SUP expiration would restore wetlands and nearshore habitats, which include areas within existing habitat for the Myrtle's silverspot butterfly and California red-legged frog. These restoration activities would result in long-term beneficial impacts on butterfly and frog habitat, affecting up to 5 acres.

Maintenance of red-legged frog ponds would improve breeding habitat and critical habitat for the frogs and would result in beneficial impacts on the frog. Nonmotorized boats, including kayaks, could potentially flush federally listed birds in the project area. As such, continued kayaking within Drakes Estero would result in long-term minor adverse impacts on the western snowy plover and California least tern. Planning and management activities may allow for use of motorized boats within Drakes Estero for research or administrative purposes. The noise generated by these boats may cause flushing of the western snowy plover and California least tern; however, boat use within Drakes Estero is subject to minimum requirement and minimum tool analysis under the Wilderness Act, would be highly infrequent and timing and location of access could be limited. Therefore, the adverse impacts from these activities would be less than minor. Recent coastal watershed restoration efforts within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) included the enhancement of habitat for Coho salmon and California steelhead to improve potential fish passage. These efforts could result in long-term beneficial impacts on special-status species by improving fish migration opportunities within the project area and the larger watershed.

The MLPA prohibits the take of any living marine resource within a marine protection area, except recreational clam gathering and commercial shellfish aquaculture. Since federally listed fish and birds can all feed on marine organisms, efforts associated with the MLPA have had and would continue to have a long-term beneficial impact on the Coho salmon, California steelhead, western snowy plover, and California least tern.

Based on the information above and despite some cumulative adverse impacts, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of past, present, and reasonably foreseeable future actions, when combined with long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on special-status species. Alternative A would contribute a noticeable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on special-status species (federally listed animal species) and critical habitat. Alternative A may also result in short-term minor adverse impacts to special-status species during removal of DBOC facilities and personal property because

removal could disturb individuals or cause temporary sedimentation within designated critical habitat. The short-term impacts related to removal would be highly localized and would last up to two months. The cumulative impact would be long-term beneficial, and alternative A would contribute a noticeable beneficial increment to the overall cumulative impact.

For all special-status species discussed above, alternative A would be consistent with relevant law and policy. Alternative A would forward the goal set forth in *NPS Management Policies 2006*, which states that the NPS will “survey for, protect, and strive to recover all species native to national park service units that are listed under the Endangered Species Act” (NPS 2006d). Alternative A would also fulfill the federal mandate set forth by the ESA to conserve listed species and ensure that their actions do not jeopardize the continued existence of the listed species.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact special-status species include:

- Continued vehicle traffic accessing DBOC
- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

Myrtle’s Silverspot Butterfly. The alternative B elements that could impact the Myrtle’s silverspot butterfly are limited to the onshore portion of the project area, including the access road and the existing structures. The portion of the road used to access DBOC onshore facilities is built within the existing coastal scrub communities that surround Drakes Estero and provide habitat for the Myrtle’s silverspot butterfly. The access road is used daily either by DBOC delivery trucks or DBOC employee vehicles. In addition, DBOC estimates that approximately 50,000 people visit DBOC annually (DBOC 2010n;^{xv} NPS 2011a). Vehicular use of the access road increases the potential for incidental butterfly mortality resulting from vehicle strikes.

Potential impacts are also associated with the existing onshore structures that would continue to be used by DBOC under alternative B. The land beneath these structures could support vegetation associated with the coastal scrub habitat used by Myrtle’s silverspot butterfly. Therefore, the continued presence of these onshore DBOC structures displaces potential butterfly habitat. In addition, under alternative B, the NPS would not install a gate to enforce seasonal closures to recreational access to Drakes Estero during harbor seal pupping season. Thus, traffic levels over the access road would be expected to continue at current levels.

Overall, alternative B would have long-term minor adverse impacts on Myrtle’s silverspot butterflies due to the continued potential for individual incidental mortality and potential habitat loss.

California Red-legged Frog Critical Habitat. Alternative B elements that could impact the California red-legged frog are limited to the onshore portion of the project area, including the access road

and the existing structures. The road used to access DBOC onshore facilities is built within the potential nonbreeding habitat for the red-legged frog. The road is used daily either by DBOC delivery trucks or DBOC employee vehicles. In addition, approximately 50,000 people visit DBOC annually (DBOC 2010n; NPS 2011a). Vehicular use of the access road increases the potential for incidental red-legged frog mortality resulting from vehicle strikes.

Potential impacts are also associated with the existing onshore DBOC structures that would continue to be used for shellfish operations under alternative B. The California red-legged frog disperses from breeding habitat into non-breeding habitat to forage, rest, and seek refuge from predators. As stated in chapter 3, the frogs can disperse great distances to carry out these normal biological activities. Under natural circumstances, the land beneath these structures could support vegetation associated with the nonbreeding habitat required by the California red-legged frog. Therefore, the presence of these onshore DBOC structures prevents the growth of potential frog habitat and degrades the frog's critical habitat. In addition, under alternative B, the NPS would not install a gate to limit recreational access to Drakes Estero during harbor seal pupping season. Thus, traffic levels over the access road would be expected to continue at current levels.

Overall, alternative B would result in long-term minor adverse impacts to California red-legged frogs for an additional 10 years because maintenance of DBOC facilities could result in degradation of a relatively small proportion of critical habitat.

Central California Coho Salmon Critical Habitat. DBOC operations and facilities in the offshore portion of the project area degrade the quality of Coho salmon critical habitat. DBOC activities, particularly boat traffic, adversely impact eelgrass biomass and abundance because plants are uprooted or otherwise physically damaged by boat propellers (NAS 2009). Eelgrass beds provide complex habitat elements within the estuarine food web, serve as a direct food source for salmon and salmon prey, and provide cover for predator avoidance (PFMC 2003). Mariculture racks could also have implications on Coho salmon critical habitat in Drakes Estero, as structures in other shallow estuaries have been shown to attract predatory fish and birds, which would increase predation on juvenile salmon (The Watershed Company 2000). Even though the Coho salmon is not currently present in Drakes Estero, by negatively influencing the salmon's critical habitat, these disturbances may reduce the potential for the Drakes Estero watershed to be used by the Coho salmon in the future.

Overall, alternative B would result in long-term minor impacts on California Coho salmon designated critical habitat for an additional 10 years because the impacts on eelgrass could cause a change in a relatively small proportion of designated critical habitat.

Central California Steelhead. Estuaries provide habitat for adult steelhead migrating upstream and for juvenile steelhead migrating downstream for feeding, transition to saltwater, and refuge (CDFG 1996). As described in the "Impacts on Eelgrass" section of this chapter, DBOC motorboat traffic adversely impacts eelgrass biomass and abundance because plants are uprooted or otherwise physically damaged by boat propellers (NAS 2009). Eelgrass beds provide complex habitat elements within the estuarine food web, serve as a direct food source for steelhead and steelhead prey, and provide cover for predator avoidance (PFMC 2003). The racks used in commercial shellfish operations could also have implications on steelhead in Drakes Estero. As with Coho salmon, structures in other shallow estuaries have been

shown to attract predatory fish and birds, which would increase predation on juvenile steelhead (The Watershed Company 2000).

Overall, alternative B would have long-term minor adverse impacts on the central California steelhead for an additional 10 years because continued damage to eelgrass could degrade a relatively small proportion of steelhead habitat.

Leatherback Sea Turtle Critical Habitat. Under alternative B, DBOC's commercial shellfish operations would continue to utilize motorboats within Drakes Estero. Because a critical habitat designation includes habitats that are considered essential to the conservation of a federally listed species, human activity within critical habitat areas can cause degradation of essential habitat's quality (see the "Impacts on Eelgrass" section for additional detail). The use of motor boats in Drakes Estero in alternative B would potentially degrade the quality of a proposed critical habitat area for the leatherback sea turtle. Overall, alternative B would result in long-term minor adverse impacts on the leatherback sea turtle for an additional 10 years due to the potential to degrade a relatively small proportion of proposed critical habitat .

Western Snowy Plover. Alternative B could impact the potential for the plover to use the DBOC offshore permit area for non-nesting habitat and biological activities. NAS (2009) notes that oyster culture bags placed on intertidal flats prevent birds from accessing sediments beneath the bags, which removes potential foraging habitat for shorebirds that feed on benthic invertebrates. NAS (2009) also notes that other shorebirds may benefit from enhanced foraging on small crustaceans and other invertebrates growing on and around intertidal bags and other mariculture structures. In addition, based on research conducted in nearby Tomales Bay (Kelly et al. 1996), as well as similar settings in Europe (Stillman et al. 2007), boat trips and activities of oyster operations cause birds to flush, which disrupts biological activities such as foraging and resting and results in reduced fitness due to the energy expended in flight (NAS 2009). This type of response would be expected in Drakes Estero as a result of DBOC operations, which involve daily boat trips and visits to multiple locations throughout Drakes Estero. These potential disturbances could limit or interrupt opportunities for the western snowy plover to forage successfully and result in detriments to successful migration and overwintering. Disturbances to plovers by boat traffic would be controlled somewhat by the year-round requirement for DBOC motorboats to maintain 100 yards from hauled out seals. The potential foraging habitat for the plover coincides with the intertidal flats used seasonally by harbor seals to haul out. Therefore, actions under alternative B would continue to reduce the potential for California least tern to use the DBOC offshore permit area for non-nesting habitat and biological activities.

Overall, alternative B would be anticipated to result in long-term minor adverse impacts on the western snowy plover for an additional 10 years because ongoing DBOC operations in Drakes Estero have the potential to disturb individuals.

California Least Tern. As described in the impact analysis for the western snowy plover, potential disturbances resulting from DBOC operations (such as the presence of bags and use of motorboats) could limit opportunities for the tern to forage successfully and result in detriments to successful migration and overwintering. Since potential foraging habitat for the tern coincides with the intertidal flats used by harbor seals to haul out, some reduction in these effects may occur. Actions under alternative B would

continue to reduce the potential for California least tern to use the DBOC offshore permit area for non-nesting habitat and biological activities.

Overall, alternative B would be expected to result in long-term minor adverse impacts on the California least tern for an additional 10 years because the continued DBOC activities in Drakes Estero would have the potential to disturb individuals.

Alternative B Summary. Based on the information provided above, alternative B would result in long-term minor adverse impacts on special-status species due to the continued operation of a commercial shellfish operation within Drakes Estero for an additional 10 years.

Upon expiration of the SUP in 2022, DBOC's operations would cease and the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes to species status species. Impacts on federally listed animal species associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact special-status species within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include kayaking, monitoring/managing invasive species, management of red-legged frog ponds, planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative B would result in a long-term beneficial cumulative impact on special-status species. Alternative B would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on special-status species beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative B would result in continued long-term minor adverse impacts on federally listed animal species for an additional 10 years because ongoing DBOC operations could cause a disruption in individuals and/or designated critical habitat. Cumulative impacts would be long-term beneficial, and alternative B would contribute a noticeable adverse increment to the overall cumulative impact.

For all special-status species discussed above, alternative B would be consistent with relevant law and policy. However, alternative B would not fulfill the goals articulated in NPS *Management Policies 2006*

as well as alternative A. NPS *Management Policies 2006*, which states that the NPS will “survey for, protect, and strive to recover all species native to national park service units that are listed under the Endangered Species Act” (NPS 2006d). USFWS and NMFS are given the authority under the ESA to determine whether or not actions jeopardize the continued existence of listed species. NPS will complete consultation with USFWS and/or NMFS would be prior to the release of the final EIS to ensure that the action would not jeopardize the species’ continued existence or result in destruction or adverse modification of critical habitat.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact special-status species are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC’s racks and bags would occupy the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any difference in impacts.

As a result, alternative C would result in long-term minor adverse impacts on special-status species due to the continued operation of a commercial shellfish operation within Drakes Estero for an additional 10 years.

Upon expiration of the SUP in 2022, DBOC’s operations would cease and the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes to species status species. Impacts on federally listed animal species associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact special-status species within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include kayaking, monitoring/managing invasive species, management of red-legged frog ponds, planning and management activities, coastal watershed restoration projects (Geomorphologic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative C, would result in a long-term beneficial cumulative impact on special-status species. Alternative C would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on special-status species beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative C would result in continued long-term minor adverse impacts on federally listed animal species for an additional 10 years because ongoing DBOC operations could cause a disruption in individuals and/or designated critical habitat. Cumulative impacts would be long-term beneficial, and alternative C would contribute a noticeable adverse increment to the overall cumulative impact.

For all special-status species discussed above, alternative C would be consistent with relevant law and policy. However, alternative C would not fulfill the goals articulated in *NPS Management Policies 2006* as well as alternative A. *NPS Management Policies 2006*, which states that the NPS will “survey for, protect, and strive to recover all species native to national park service units that are listed under the Endangered Species Act” (NPS 2006d). USFWS and NMFS are given the authority under the ESA to determine whether or not actions jeopardize the continued existence of listed species. NPS will complete consultation with USFWS and/or NMFS would be prior to the release of the final EIS to ensure that the action would not jeopardize the species’ continued existence or result in destruction or adverse modification of critical habitat.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact special-status species include:

- Increased production limit
- New onshore development
- Increased visitation to DBOC

Increased shellfish production and visitation under alternative D would likely result in more vehicular traffic and human activity than the other alternatives. Accordingly, the risk of vehicle strikes to the Myrtle’s silverspot butterfly and the California red-legged frog would be higher than the other alternatives. The risk of human disturbance to these species would also be highest under this alternative. Construction and demolition activities associated with redevelopment plans could further increase vehicular traffic on and in the immediate vicinity of the access road, increasing the potential for mortality from vehicle collisions for the duration of demolition and construction (anticipated to be less than a year). Any placement of construction or demolition debris within potential butterfly or frog habitat areas would further reduce the area available to the species, resulting in a short-term adverse impact. The long-term impacts to these species and their habitat would continue to be minor and adverse; however, alternative D

would also be expected to have short-term minor adverse impacts on the Myrtle's silverspot butterfly and California red-legged frog critical habitat during construction.

Under alternative D, DBOC could produce up to 850,000 pounds of shellfish annually. This is an increase over the production limits under alternative B (600,000 pounds per year) and alternative C (500,000 pounds per year). The increase in shellfish production levels could result in an increase of DBOC offshore operations, including more mariculture material within the 138 delineated culture beds and motorboat traffic. As a result, potential impacts on federally listed species from increased vessel traffic and mariculture material may be different from alternatives B and C. Although impacts on the offshore resources in Drakes Estero, including eelgrass, may be greater than under the other alternatives, the increased production is expected to result in continued long-term minor adverse impacts on special-status species and critical habitat, including central California Coho salmon critical habitat, central California steelhead, leatherback sea turtle critical habitat, western snowy plover, and California least tern.

Therefore, alternative D would result in long-term minor adverse impacts on special-status species for an additional 10 years due to the continued operation of a commercial shellfish operation within Drakes Estero. The impacts of alternative D may be greater than alternatives B and C, but are still expected to be minor in intensity. Alternative D would also have short-term minor adverse impacts on Myrtle's silverspot butterfly and California red-legged frog critical habitat during redevelopment of the site because of the potential for habitat to be displaced and the increased risk for vehicle strikes.

Upon expiration of the SUP in 2022, DBOC's operations would cease and the NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes to species status species. Impacts on federally listed animal species associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness in 2022 would be similar to those discussed under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact special-status species within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include kayaking, monitoring/managing invasive species, management of red-legged frog ponds, planning and management activities, coastal watershed restoration projects (Geomorphologic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative D, would result in a long-term beneficial cumulative impact on special-status species. Alternative D would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on special-status species beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative D would result in long-term minor adverse impacts on special-status species for an additional 10 years due to the continued operation of a commercial shellfish operation within Drakes Estero. As discussed above, the impacts of alternative D may be greater than alternatives B and C due to increased production levels (approximately 40 percent greater than alternative B and 70 percent greater than alternative C). Alternative D would also have short-term minor adverse impacts on Myrtle's silverspot butterfly and California red-legged frog critical habitat during redevelopment of the site because of the potential for habitat to be displaced and the increased risk for vehicle strikes. The cumulative impact would be long-term beneficial, and alternative D would contribute a noticeable adverse increment to the overall cumulative impact.

For all special-status species discussed above, alternative D would be consistent with relevant law and policy. However, alternative D would not fulfill the goals articulated in NPS *Management Policies 2006* as well as alternative A. NPS *Management Policies 2006*, which states that the NPS will “survey for, protect, and strive to recover all species native to national park service units that are listed under the Endangered Species Act” (NPS 2006d). UFWFS and NMFS are given the authority under the ESA to determine whether or not actions jeopardize the continued existence of listed species. NPS will complete consultation with USFWS and/or NMFS would be prior to the release of the Final EIS to ensure that the action would not jeopardize the species' continued existence or result in destruction or adverse modification of critical habitat.

IMPACTS ON COASTAL FLOOD ZONES

LAWS AND POLICIES

Coastal flood zones often include a variety of habitat types found below the 100-year base flood elevation that may include estuaries, salt marshes, mudflats, shoreline beaches, dunes, and maritime vegetated uplands. Protection of these resources provides an ability to absorb the forces of catastrophic flood events thereby protecting other sensitive riparian habitats. Presidential Executive Order 11988, “Floodplain Management” and the subsequent NPS Director's Order 77-2 and *Procedural Manual 77-2: Floodplain Management* are intended to properly conserve, manage, and protect flood zones on NPS lands. The federal CZMA and the California Coastal Act are additional legislation intended to protect flood zones. The purpose of regulating activities within the flood zone is to protect human health and the environment and prevent damage to property in the event of a catastrophic flood event. Drakes Estero (including the waters of the Estero and surrounding lands up to approximately 9.0 feet above sea level) falls within the coastal flood zone which is an area with the probability of being inundated at least once every 100 years due to coastal storms and tsunamis. Construction within the flood zone at Drakes Estero would require compliance with Director's Order 77-2 and related state/federal laws. Marin County is the local government to review the design plans of any proposed work within the Drakes Estero flood zone as per Chapter 23-9 of the Marin County zoning ordinance. This ordinance is designed to comply with state and federal regulations to insure structures are installed in a manner that minimizes impacts to flood zones, such as having floor elevations above the base flood elevation, use of acceptable building materials, and properly anchored structures to pilings/columns.

In accordance with *Procedural Manual 77-2: Floodplain Management*, a Statement of Findings (SOF) must be prepared if a proposed action associated with the selected alternative is found to be within a regulatory floodplain. Alternatives A, B, and C do not include any new structures. Only Alternative D would have a new structure within the flood zone requiring the need for an SOF. The SOF would be included in the appropriate environmental compliance documents prepared for the new building as required by NEPA and DO-12.

METHODOLOGY

A 100-year flood zone elevation for Drakes Estero has not been determined by FEMA. The closest flood zone elevation determination was conducted for Bolinas Beach, approximately 17 miles south of Point Reyes, where the 100-year flood elevation is 8.2 feet North American Vertical Datum 1988 (NAVD'88). The focus of flood zone impacts for each alternative centers on the onshore operations and facilities that would be inundated during a flood event. Chapter 3 details the analysis of land survey data tied to tidal gauge data used to estimate the elevation of inundation from a major storm surge and wave runup. For purposes of this impacts analysis, an elevation of 9.0 feet NAVD-88 was estimated as the flood zone elevation for Drakes Estero based on the land survey at the onshore facilities and gauge data from the Point Reyes Light Station.

The NPS *Procedural Manual 77-2* requires that structures and facilities within the flood zone be designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR 60). Structures must have professionally engineered flood-proofing measures to manage flood hazards. In addition, flood warning and evacuation plans must be designed and determined to be adequate to manage flood hazards.

Procedural Manual 77-2 also applies to actions that are functionally dependent upon locations in proximity to water and for which non-floodplain sites are never a practicable alternative. Examples of actions functionally dependent upon water include: marinas, docks, piers, water intake facilities, sewage outfalls, bridges, flood control facilities, water monitoring stations, drainage ditches, debris removal, outdoor water sports facilities, boardwalks to interpret wetlands, and similar water-dependent actions. Procedural Manual 77-2 requires that such structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60). Certain park functions, however, do not require adherence to Procedural Manual 77-2 when they are often located near water for the enjoyment of visitors, such as scenic overlooks, foot trails, and associated daytime parking provided the impacts of these facilities on floodplain values are minimized. In addition, entrance, access, and internal roads to or within units of the national park system are excepted from the requirements of Procedural Manual 77-2, as are historic or archeological sites or artifacts whose location is integral to their significance.

This section will evaluate the impacts to properties located within the estimated 100-year flood zone for each alternative and the impacts of flood events on the proposed actions under consideration. The following terminology is used in describing impacts on the floodplains and flood zones:

- Minor:** The action would take place within the floodplain or flood zone, but would not result in an increase in potential flood damage to other areas, or is exempt from NPS floodplain management guidelines.
- Moderate:** The action would take place within the floodplain or flood zone and would result in increased potential for flood damage to property or environmental contamination at the project site.
- Major:** The action would have a measurable impact on potential flood damage or environmental contamination to the site as well as adjacent and downstream properties.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The removal of existing on and off-shore structures would result in beneficial impacts on the Drakes Estero coastal flood zone from the elimination of risks associated with dislodged and damaged materials floating and washing ashore during a flood event. The removal of materials that have the potential to adversely affect water quality if spilled during a flood event, such as stored fuels and wastewater, would also be beneficial.

Under this alternative, certain buildings and structures, other personal property, and shell piles would be removed. Removal of these items would result in an increase of flood zone capacity equal to the volume of the items removed. Given the size of the estuary and its watershed (approximately 31 acres), this increase would be relatively small. The removal of these items would also result in long term beneficial impacts to the coastal flood zone by slightly increasing the area's flood storage capacity (see discussion under alternative B).

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact the coastal flood zone within the project area. These actions include restoration of the developed onshore area following SUP expiration and moving the vault toilet away from the shoreline.

Restoration of the developed onshore area following SUP expiration in year 2012 would restore natural wetlands and upland vegetation communities that would provide added flood storage capacity and protect shoreline erosion from a catastrophic storm event. These restoration activities would result in beneficial impacts on coastal flood zones within the project area. Additionally, moving the vault toilet away from the shoreline and out of the flood zone would remove the risk of wastewater leaking and mixing with water from Drakes Estero during a catastrophic flood event. As such, relocating the vault toilet would result in beneficial impacts on the coastal flood zone within the project area.

Based on the information above, the impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact on coastal flood zones. Alternative A would contribute a noticeable beneficial increment to the cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on the coastal flood zone due to an increase in flood storage capacity of the onshore area and the removal of structures and materials that have the potential to cause damage during a flood event. The cumulative impact would be beneficial, and alternative A would contribute a noticeable beneficial increment to the cumulative impacts.

With respect to coastal flood zones, alternative A is consistent with relevant law and policy. Removal of structures and residences within the flood zone would fulfill the goals set forth by Presidential Executive Order 11988, “Floodplain Management” and the subsequent NPS Director’s Order 77-2 and *Procedural Manual 77-2: Floodplain Management*, which are intended to properly conserve, manage, and protect flood zones on NPS lands to protect human health and the environment and prevent damage to property in the event of a flood event.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact the coastal flood zone include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued use and maintenance of onshore facilities, including continued provision of DBOC employee housing on site

All offshore structures and materials including shellfish racks, bags, and trays within 138 acres of Drakes Estero would remain within the coastal flood zone under this alternative. These offshore structures and materials could be damaged and/or dislodged during a flood event, potentially causing damage to resources within Drakes Estero. The loss of flood storage due to the racks and bags placed in Drakes Estero is very small and not likely to cause flooding of other properties.

The mariculture operations under this alternative would continue to use the floating dock, the conveyor dock, setting tanks, processing plant, stringing shed, shop, punching shed, and two mobile homes, which are all located within the flood zone. Other than the docks, which are exempt from NPS flood management guidelines, it is unlikely that any of the structures would meet NPS standards for structures within the coastal flood zone. The office/warehouse, main house, and cabin would also remain, although those structures and floor elevations would be above the flood elevation.

It is anticipated that the punching shed, shop, processing plant, and stringing shed would be inundated during a 100-year flood event, potentially causing damage to the structures and contents. Many of the contents of these buildings at floor level could become flooded and/or washed away and deposited into nearby sensitive areas, resulting in local contamination. Vehicles (including the forklift) and stored equipment and supplies could become inundated during a flood event. Such action could cause the release of fuels/oils into the water, as well as floating and deposition of materials across the Drakes Estero shoreline and within wetlands. Items moved by floodwaters into sensitive areas could require entry with equipment into these sensitive areas for retrieval, resulting in potential damage to wetlands and the shoreline. The two mobile homes would have water underneath the structures during a 100-year flood event, but it is expected that water would not reach the floor elevation of 11 feet.

Shell piles have been created along the shoreline of the onshore permit area within the coastal flood zone. Alternative B would allow the continued deposition of shell fragments derived from the shucking operation. These piles displace volume normally available for storage during a flood event. Adding more shells to these piles would further reduce flood storage capacity in this area.

The proposed dredging (approximately 200 cubic yards) in the vicinity of the dock for enhanced boat access would offset these impacts to a very minimal extent by creating additional flood storage capacity.

Alternative B would require the continued operation of NPS and DBOC underground septic storage tanks located within the flood zone. A 100-year flood event has the potential to overwash into the tanks, causing mixing with effluent and the leakage/spillage of wastewater into waters of Drakes Estero. Septic drain fields located on the neighboring ridge do not fall within the coastal flood zone.

Based on the information above, alternative B would have a long-term moderate adverse impact on coastal flood zones within the project area for an additional 10 years because continued DBOC operations would take place within the flood zone and would result in continued potential for flood damage to property and/or environmental contamination at the project area.

Upon expiration of the SUP in 2022, the conversion of Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts on coastal flood zones in Drakes Estero. Impacts associated with this conversion to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact coastal flood zones within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include moving the vault toilet away from the shoreline, as described in alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of this past, present and reasonably foreseeable future action would be long-term beneficial. The impact of the past, present, and reasonably foreseeable future action, when combined with the long-term moderate adverse impacts of alternative B, would result in a long-term moderate adverse cumulative impact on the coastal flood zone. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on coastal flood zones beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative B would result in long-term moderate adverse impacts on the coastal flood zone within the project area for an additional 10 years because continued DBOC operations would take place within the flood zone and would result in continued potential for flood damage to property and/or environmental contamination at the project site. Offshore structures and materials could be damaged and/or dislodged during a flood event, potentially causing damage to resources within Drakes Estero. Onshore, it is anticipated that the punching shed, shop, processing plant, and stringing shed would be inundated during a 100-year flood event, potentially causing damage to the structures and contents as well as local contamination. Shell piles would reduce flood storage capacity in the area, while proposed dredging in the vicinity of the dock would offset these impacts to some extent. Wastewater collection tanks would also be inundated during a 100-year flood event, potentially causing leaks of untreated wastewater to enter Drakes Estero. The cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

NPS guidelines require that new actions within the flood zone comply with *Procedural Manual 77-2: Floodplain Management*. This alternative would allow the continued use of nonconforming structures, and no new structures would be placed in the coastal flood zone. As such, this alternative would comply with existing NPS guidelines and procedures.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact the coastal flood zone are the same as described under alternative B.

Impacts on the coastal flood zone would be the same as described for alternative B. These include the potential dislodging of offshore equipment during a flood event, causing such equipment to float ashore.

Impacts on the coastal flood zone include those buildings and wastewater collection systems described in alternative B that are situated on land below the 9-foot elevation NAVD '88. Human occupation in the coastal flood zone would continue, and all structures and DBOC personal property would remain in the flood zone until year 2022. Impacts include the loss of flood zone functions and flood storage. Alternative C would also include the dredging of Drakes Estero at the dock creating additional flood storage capacity.

Alternative C would result in long-term moderate adverse impacts on the coastal flood zone in the project area for an additional 10 years because continued DBOC operations would take place within the flood

zone and would result in continued potential for flood damage to property and/or environmental contamination at the project site.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to coastal flood zones in Drakes Estero. Impacts associated with this conversion to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact coastal flood zones within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include moving the vault toilet away from the shoreline. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of this past, present and reasonably foreseeable future action would be long-term beneficial. The impact of the past, present, and reasonably foreseeable future action, when combined with the long-term moderate adverse impacts of alternative C, would result in a long-term moderate adverse impact on the coastal flood zone. Alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on coastal flood zones beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative C would result in long-term moderate adverse impacts on the coastal flood zone within the project area for an additional 10 years because continued DBOC operations would take place within the flood zone and would result in continued potential for flood damage to property and/or environmental contamination at the project site. Offshore structures and materials could be damaged and/or dislodged during a flood event, potentially causing damage to resources within Drakes Estero. Onshore, it is anticipated that the punching shed, shop, processing plant, and stringing shed would be inundated during a 100-year flood event, potentially causing damage to the structures and contents as well as local contamination. Shell piles would reduce flood storage capacity in the area, while proposed dredging in the vicinity of the dock would offset these impacts to some extent. Wastewater collection tanks would also be inundated during a 100-year flood event, potentially causing leaks of untreated wastewater to enter Drakes Estero. The cumulative impact would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

NPS guidelines require that new actions within the flood zone comply with *Procedural Manual 77-2: Floodplain Management*. This alternative would allow the continued use of nonconforming structures, and no new structures would be placed in the coastal flood zone. As such, this alternative would comply with existing NPS guidelines and procedures.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact the coastal flood zone are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact the coastal flood zone include:

- Increased production
- New onshore development

Alternative D would include modifications to the onshore facilities and a much higher production level compared to alternatives B and C. Onshore changes would include the removal of the existing processing plant, to be replaced by a larger, more modern facility that would serve multiple functions. Impacts to coastal flood zones resulting from the continuation of the shellfish operation for an additional 10 years under alternative D are described as follows.

Higher production levels would require the placement of more shellfish (either hanging on racks or in bags or trays) within the coastal flood zone compared to the other alternatives. These additional structures would occupy areas of flood storage, but the displacement in the flood zone is not expected to impact other areas or properties. Impacts on the flood zone from dislodged equipment floating to the shoreline would be expected to be similar to those described for alternatives B and C.

It is expected that any new development would be built in accordance with relevant standards, including local building codes. The construction of new facilities may take place within the flood zone if alternative site locations outside of the flood zone but within the SUP area were determined to be infeasible through a subsequent planning process. If located within the flood zone, new facilities would result in continued potential for flood damage to property and/or environmental contamination at the project site. Wastewater collection systems would remain as described in alternatives B and C, and flood zone impacts from other structures (punching shed, stringing shed, dock, washing station, and mobile homes) would be the same as those under alternatives B and C. An increase in production would likely result in additional shell being added to the shell piles located within the flood zone, resulting in a reduction of flood storage capacity.

Based on the information above, alternative D would result in long-term moderate adverse impacts on coastal flood zones within the project area for another 10 years because the continued operation of the commercial shellfish facility would take place within the coastal flood zone and would result in continued potential for flood damage to property and/or environmental contamination.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to coastal flood zones in Drakes Estero. Impacts associated with this conversion to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact coastal flood zones within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include moving the vault toilet away from the shoreline. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of this past, present and reasonably foreseeable future action would be long-term beneficial. The impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative D, would result in a long-term moderate adverse cumulative impact on the coastal flood zone. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on coastal flood zones beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative D would result in long-term moderate adverse impacts on the coastal flood zone due to continued mariculture operations. Existing structures are within the flood zone, which could result in increased potential for flood damage to property or environmental contamination at the project site. Compared to alternatives B and C, alternative D would result in increased flood zone impacts from the offshore facilities due to additional racks and bottom bags to accommodate the higher shellfish production level. The construction of new facilities may take place within the flood zone if alternative site locations outside of the flood zone but within the SUP area were determined to be infeasible through a subsequent planning process. If located within the flood zone, the new facility would result in continued potential for flood damage to property and/or environmental contamination at the project site. Wastewater collection systems would remain as described in alternatives B and C, and flood zone impacts from other structures (punching shed, stringing shed, dock, washing station, and mobile homes) would be the same as those under alternatives B and C. An increase in production would likely result in additional shell being added to the shell piles located within the flood zone, resulting in a reduction of flood storage capacity. The cumulative impact would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the cumulative impact.

Alternative D is the only alternative that includes new onshore development, which is a Class I Action specified in the *Procedural Manual 77-2: Floodplain Management*. As such, the new structure would require a Statement of Findings (SOF) if alternative site locations outside of the coastal flood zone but within the SUP area were determined to be infeasible. The SOF process would ensure the structure is properly designed and constructed in a way that minimizes impacts to the flood zone.

IMPACTS ON WATER QUALITY

LAWS AND POLICIES

The federal Water Pollution Control Act, more commonly known as the CWA (33 U.S.C. sections 1257-1387), was first promulgated in 1972 and later amended multiple times (e.g., 1977, 1987, and 1990). This law is designed to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters,” including the waters of the national park system. NPS policy requires that the NPS take the following steps to protect water quality.

- Work with appropriate governmental bodies to obtain the highest possible standards available under the Clean Water Act for the protection of park waters;
- Take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations; and
- Enter into agreements with other agencies and governing bodies, as appropriate, to secure their cooperation in maintaining or restoring the quality of park water resources.

NPS policy goal is to protect pristine water quality and improve impaired water quality by supporting the CWA protections and provisions for designated unimpaired and impaired waters.

Methodology

As described in chapter 3, Drakes Estero has minimal freshwater input (Press 2005), and is characterized as a shallow, open embayment, with an average subtidal depth of around 6.5 feet. Because of the open character of the lagoon and the low freshwater input, most of Drakes Estero is flushed by a semidiurnal (twice-daily) tidal cycle with a tidal range of around 6 feet, with salinities within the Estero approaching coastal Pacific salinities (around 34 parts per thousand) (NOAA 2010). The small degree of human-caused alterations (Baltan 2006) in the watershed, coupled with Drakes Estero’s short tidal flushing cycle (residence period) and the tidal flushing with upwelled oceanic water (NAS 2009) are the primary reasons for the high water quality in Drakes Estero.

In addition to the marine waters entering the Estero on each tide, there are three direct sources that affect water quality in Drakes Estero, including runoff from cattle operations within the watershed, the biological effects of the oysters, and the actions of the mariculture operation. Newell (2004) and Dumbauld, Ruesink, and Rumrill (2009) provide excellent summaries of the ecological affects of bivalves, one of which is the beneficial effect of filtering sediments and nutrients from the water column resulting in improved water quality of marine ecosystems. However, it should be noted that most of the studies showing the beneficial effects of bivalve cultivation (such as water clarity and sediment nutrient enrichment) were conducted in estuaries with relatively turbid waters full of particulates, with low to moderate tidal flushing. By contrast, Drakes Estero is not a highly turbid coastal embayment (NAS 2009), so bivalve contributions to water clarity would likely be relatively minor. In reviewing shellfish mariculture activities and their role in marine biology and water chemistry processes, the evaluation of impacts could be unnecessarily duplicated between impact topics in this EIS. This section will evaluate

impacts on water quality in the broad context of mariculture activities, while the discussion on water quality effects on specific marine and biological resources (microbenthos, subaquatic vegetation, oyster pseudofecal sediment deposition, trophic levels, eelgrass, fisheries, etc.) are discussed more thoroughly in the “Impacts on Wildlife and Wildlife Habitat: Fish,” and “Impacts on Eelgrass” sections of this chapter.

In general, human-induced impacts on water quality derive from point and non-point sources. Point sources are concentrated flows from pipes or channels entering the environment, often related to industrial operations. Non-point sources include intermittent events that enter the environment at multiple locations, such as runoff from impervious surfaces (roofs, parking areas, roadways, docks), surface runoff containing nutrients or leached pesticides, and possibly contaminated groundwater sources laterally entering the surface water. This section discusses non-point sources specific to land development and the mariculture activities such as onshore stormwater runoff, boat operation, pulse disturbances to the Estero substrate from maintaining oyster racks and placing/overturning/removing bottom bags in the Drakes Estero intertidal zone, accidental spill of fuel/oil, accidental spill/leaks of wastewater from underground septic tanks, and cattle waste from nearby pastures. Point sources include the discharge of pumped water from Drakes Estero used to fill the setting tanks and to wash harvested shellfish. There are no known uses of pesticides or foreign chemicals associated with the discharge of the water from the setting tanks and the washing station.

Impact intensity levels for water quality are developed for this section to discern differences between alternatives. This can only be qualitatively evaluated because empirical on-site water quality parameters for each proposed action are not possible.

Intensity Definitions

Minor:	Minor water quality impacts would include temporary, localized impacts that may or may not be detectable, would not have long-lasting effects on water quality, and would be within historical or desired water quality conditions.
Moderate:	Moderate impacts are short-term and long-term detectable impacts that would change the chemical, physical, or biological integrity of water quality to the degree that the action would alter the historical baseline or desired water quality conditions of Drakes Estero.
Major:	Major impacts are short-term and long-term detectable impacts that would change the chemical, physical, or biological integrity of waters of Drakes Estero to the degree that the action would alter the historical baseline or desired water quality conditions.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and

structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Oysters, as filter feeders, provide water quality benefits in some systems through the removal of suspended solids, nutrient uptake and sequestration, consumption of phytoplankton, and lowering of water turbidity (Gilbert et al. 1997; Higgins, Stephenson, and Brown 2011; Newell 2004; Mazouni et al. 1996; Minjeaud et al. 2009; Dumbauld, Ruesink, and Rumrill 2009). In the context of Drakes Estero, nutrient inputs are primarily a function of Drakes Estero's physiographic structure allowing tidal flushing from upwelling with short residence periods (NAS 2009; Dumbauld, Ruesink, and Rumrill 2009). Water quality monitoring conducted by the CDPH indicates that the inputs from upstream sources such as the cattle ranches affect the pathogen levels in the upper arms of the Estero resulting in the establishment of the "Water Quality Prohibited Areas" where shellfish harvest is prohibited (Zubkousky 2010). This characteristic, coupled with few human-caused disturbances in a relatively small watershed (Zubkousky 2010), are the overriding properties of Drakes Estero affecting water quality. Therefore, while ceasing mariculture operations would end the ability of the oysters to filter water within Drakes Estero, any appreciable differences in water quality may be restricted to areas immediately adjacent to structures (Dumbauld, Ruesink, and Rumrill 2009).

Water quality monitoring data collected from Drakes Estero reveal that the water quality standards are far below the thresholds required for contact recreational use (including swimming and boating). The removal of the shellfish mariculture facilities and operations would not be expected to modify the water quality appreciably, or to a level that would prohibit the continued use of Drakes Estero for recreation. Long-term beneficial impacts on water quality would occur from removing sources of potential hydrocarbon spills, eliminating bottom scarring caused by motorized boats, and removing the potential for sediment transfer around racks and bags from tidal flows. The wooden racks and docks at Drakes Estero would be removed under this alternative. These wooden structures, however, have been in contact with water in Drakes Estero for years and are not expected to continue the release of wood preservative leachates into the aquatic environment (Sanger and Holland 2002). In addition, equipment from the racks and bags have often become dislodged and found floating in Drakes Estero or washed up on mudflats and shorelines. The primary debris associated with commercial shellfish production that has been observed in and along the shores of Drakes Estero includes the plastic spacers used in hanging culture (to separate clumps of oysters) and Styrofoam floats (used for floating bags). Under this alternative, all racks and bags would be removed, and water quality would be further enhanced by eliminating the potential to dislodge debris from current locations.

Removal of the offshore infrastructure is expected to cause temporary (lasting up to two months) sediment disturbances to the Drakes Estero bottom, resulting in particulate accumulation within the immediate work area. This would be a one-time action, compared to pulse disturbances from multiple visits to the offshore infrastructure related to continued oyster cultivation under the action alternatives. Sediment disturbances from walking personnel dismantling the racks and collecting bags, boats, anchors, etc. would cause a temporary increase in turbidity that could affect localized fish and shellfish populations. Sediment plumes from facility removal would dissipate as the tidal flushing cycles bring new supplies of oceanic water to replenish Drakes Estero. There would be no further need for water quality sampling, which would eliminate the need for boat traffic to the water quality stations.

Onshore operations would cease under alternative A, and DBOC equipment and personal property would be removed. DBOC would also remove several structures from the onshore area. NPS would consider removal of other existing structures, such as the dock. Such actions may cause onshore soil disturbances, resulting in a temporary increase in non-point-source runoff pollution until the area is stabilized. Sediment erosion into neighboring wetlands or waters could cause local turbidity levels to temporarily rise, impacting wildlife and fish habitats in waters and wetlands. Tidal flushing would dissipate any turbid waters, resulting in these impacts being short-term.

Removal of onshore facilities may provide long-term benefits to water quality with the elimination of impervious surfaces that are non-point sources of water pollutants. DBOC operations include several wastewater tanks and pumps at the onshore facilities. Wastewater is pumped into two underground drain fields located upslope from the operations facility. While the wastewater system would remain, the level of use would be substantially reduced or eliminated, and the risk of wastewater entering Drakes Estero from a treatment facility failure or pumping leaks would cease.

Use of the setting tanks and the washing station would end under this alternative. As such, water would no longer be pumped from Drakes Estero for these two operations, and the discharge of secondary contaminants normally included in the wastewater, such as sediments attached to harvested shellfish and fouling aquatic organisms, would no longer be released back into Drakes Estero.

Vehicular traffic to and from the operations facility is dictated by employee travel, distribution/delivery trucks, and visitors to DBOC. The termination of the commercial shellfish operations would eliminate the vehicle use associated with it, resulting in fewer sources of fuels/oils and other pollutants entering Drakes Estero. This would provide long-term beneficial impacts on water quality.

NPS facilities would remain under this alternative. Non-point sources of pollutants reaching Drakes Estero would continue from the access road and canoe/kayak parking lot, although there would be less stormwater runoff compared to the runoff resulting from the action alternatives. These sources would be very small due to the limited use the parking lot receives, and would have a minor adverse effect on the Drakes Estero ecosystem as a whole. The vault toilet near surface waters and wetlands would also remain. These facilities pose a slight risk of fecal coliform being introduced to Drakes Estero from pumping spills or undetected leaks. Such contaminants could temporarily affect water quality for aquatic species until flushed by tidal action or absorbed by biological processes. No spills have occurred in the past, and it is unlikely that the vault toilet would cause adverse impacts on water quality. Relocation of the vault toilet is identified as a cumulative project below.

As describe above, alternative A would result in long-term beneficial impacts on water quality due to the reduction of non-point-source runoff and the elimination of future disturbances to the Drakes Estero bottom from boats and offshore structures. Removal of the racks and bags would cause a short-term minor adverse impact on water quality due to the sediment disturbances from personnel removing the offshore structures. These adverse impacts would be temporary and localized.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact water quality within the project area. These actions include restoration of the developed onshore area following SUP expiration, the existing fire management plan, coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), existing ranching operations, and moving the vault toilet away from the shoreline.

Restoration of the developed onshore area following SUP expiration would remove remaining infrastructure from the onshore areas, including the wastewater treatment system, and would establish natural wetlands and upland vegetation communities that serve as natural shoreline buffers for filtering pollutants. These restoration activities would result in long-term beneficial impacts on water quality within the project area. Fire management activities associated with the Seashore's current fire management plan could result in the runoff of ash and nutrients into Drakes Estero. This runoff would result in a minor adverse impact on water quality within the project area. Additionally, recent coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) included stabilization of existing structures with the potential to fail. If these structures were to fail, sediment would be washed downstream. As such, recent watershed restoration efforts have resulted in beneficial impacts on water quality within Drakes Estero. Ranching activities, such as those performed within the Seashore, introduce animal waste (fecal coliform) into the watershed via runoff. Continued ranching within the project area would result in minor adverse impacts on the water quality of Drakes Estero. Moving the NPS vault toilet away from the shoreline would remove the risk of wastewater leaking and mixing with water from Drakes Estero during a catastrophic flood event resulting in beneficial impacts on the water quality within Drakes Estero.

Based on the information above, the impact of these past, present, and reasonably foreseeable future action would be long-term minor adverse. The impact of these past, present, and reasonably foreseeable future actions, when combined with the short-term minor adverse and long-term beneficial impacts of alternative A, would result in a long-term beneficial cumulative impact to water quality within Drakes Estero. Alternative A would contribute a noticeable beneficial increment to the cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on water quality as a result of reduced non-point-source runoff and the elimination of future disturbances to the Drakes Estero bottom from boats and offshore structures. Bivalves filter and process suspended solids, nutrients, and phytoplankton from the water column resulting in cleaner, less turbid water. Drakes Estero is not a highly turbid coastal embayment (NAS 2009), so bivalve contributions to water clarity would likely be limited relatively minor and limited. Based on west coast research (Dumbauld, Ruesink, and Rumrill 2009), the positive ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would be expected to be relatively minor in west coast estuaries like Drakes Estero. This is because the nutrient dynamics in these systems are driven by coastal upwelling and a strong tidal cycle which flushes small estuaries like Drakes Estero on a daily basis. However, to the extent that localized beneficial effects from DBOC bivalves influence eelgrass productivity near DBOC beds and racks (see discussion under alternative B), the removal of DBOC-cultured bivalves under alternative A would result in adverse

impacts on eelgrass at these sites. Thus, minor adverse impacts to water quality in Drakes Estero would be expected to occur under this alternative. Removal of the racks and bags would cause a short-term minor adverse impact on water quality due to the sediment disturbances from personnel removing the offshore structures. These adverse impacts would be temporary and localized. The cumulative impact would be long-term beneficial, and alternative A would contribute a noticeable beneficial impact to the cumulative impact.

With regards to water quality, alternative A would satisfy the goals and objectives of *NPS Management Policies 2006* (NPS 2006d) and would be consistent with the purpose of the CWA, which is to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.”

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact water quality include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

As filter feeders, shellfish provide beneficial water quality functions with their ability to remove suspended solids, nutrients, and phytoplankton from the water column. Pollutants that enter Drakes Estero from cattle operations and other non-point sources have the potential to be captured and processed by the cultivated shellfish. Under this alternative, cultivated shellfish would remain in Drakes Estero providing localized benefits to water quality by removing those pollutants entering the water.

Impacts on water quality from managing the offshore facilities would be expected to be intermittent, occurring when employees visit racks and bags. Such impacts include temporary pulse sediment disturbances to the Drakes Estero bottom, resulting in higher than normal particulate concentrations within the localized work area as DBOC employees manage racks and install, harvest, or flip bags and trays lying on the floor of Drakes Estero. These pulse disturbances include workers walking across mudflats, boat hulls running aground on the mudflats, and bag maintenance/harvesting actions. These activities occur up to eight hours a day, resulting in temporary disturbances affecting water quality. Such impacts increase turbidity, affecting fish and shellfish habitat in the immediate vicinity of the work area and causing sediment plumes that may affect nearby eelgrass beds. Sediment plumes from offshore operations would dissipate through daily tidal flushing. Motorized boat traffic is necessary to manage the offshore facilities and would continue under this alternative, resulting in intermittent sediment disturbances and substrate scarring from propellers when boats enter shallow waters outside established deep-water channels. Water quality would be impacted by temporary increased turbidity levels.

Boats are fueled by hand, using gasoline/oil products from 6-gallon containers approved for fuel storage. There are no underground fuel tanks at the project site. Accidental spills may occur while pouring fuel into boat tanks using the 6-gallon containers. Such fuel/oil spills could enter Drakes Estero and become

consumed by or attached to local fish and wildlife. However, because fuels are handled in small-volume containers, the risk of large fuel spills causing significant water quality impacts is very small.

Wooden racks and docks constructed from pressure-treated lumber would remain until year 2022. Existing racks and docks were built using purchased lumber treated with a preservative solution under extreme pressure. The most commonly used chemical treatment for marine use is chromate copper arsenate (CCA). Most of the CCA remains affixed to the wood fibers; however, some may leach into the aquatic environment once exposed to rain or submersed in water (Brooks 1996; Weis and Weis 1996). As described by Sanger and Holland (2002), the vast majority of any leachates from the wood preservatives entering the water and sediment occur within the first 90 days of installation. The DBOC structures are far older than 90 days, and the active leaching of wood preservatives into Drakes Estero has ended, for the most part. Over the 10-year permit period under this alternative, however, maintenance and repairs to racks and the dock are expected. This action would introduce new treated lumber into the aquatic environment resulting in CCA leaching into the water column. Even so, any wood preservatives that may leach into the water would be diluted to non-toxic levels by daily tidal flushing (Sanger and Holland 2002).

Over the years, the washing of harvested oysters at the onshore facilities near the existing floating dock has resulted in the accumulation of sediments and shell fragments returning into Drakes Estero. Alternative B calls for the dredging of a 30-foot by 60-foot area immediately around the floating dock to provide boat access to the dock. Dredging would be done using an excavator backhoe to remove the sediment. A total of approximately 200 cubic yards of sediment would be dredged and loaded onto dump trucks for hauling to an approved deposition site. Water quality impacts from dredging actions include increased turbidity in the localized work area. Impacts from this action could be mitigated with the use of a floating siltation curtain surrounding the work area in order to contain suspended sediments to the disturbed area.

Sediment disturbances to the Drakes Estero bottom from all offshore activities have the potential to release pesticides and herbicides that may have accumulated in the sediment over time into the water column. An analysis of sediment cores sampled by Anima (1990) in Drakes Estero found the level of herbicides and pesticides to be “low or below the analytical cutoff points for the compounds tested, except for DDE (Dichlorodiphenyldichloroethylene), which in Schooner Bay, Estero de Limantour, Abbotts Lagoon, Barries Bay, and Creamery Bay did show concentrations between 0.1 to 2.1 µg/kg.” The detection limit for DDE was 0.1 µg/kg. By comparison, Anima (1990) reports the NAS National Academy of Engineering recommended safe level as “1,000 µg/kg (sum of DDD, DDE, and DDT) wet weight for the protection of fish eating wildlife.” Due to the very low levels of herbicides/pesticides detected in the Drakes Estero sediment by Anima (1990), impacts on water quality from dissipation of these disturbed chemicals during dredging would be expected to be short-term.

Water quality monitoring data collected from Drakes Estero reveal that the water quality standards are far below the thresholds necessary to prohibit recreational use. The continuation of the mariculture offshore operations is not expected to modify the water quality to a level that would prohibit the continued use of Drakes Estero by visitors seeking to use it for recreational purposes.

Onshore operations under alternative B would continue using the existing DBOC equipment and structures. These facilities have impervious surfaces, creating a non-point-source of runoff that enters Drakes Estero during rain events. The degree of pollutant loading, however, is very low given the small

amount of impervious surface (less than 3 acres—a very small percentage of the entire watershed). Tidal flushing would dissipate such pollutant loads to within acceptable water quality levels.

Alternative B would result in discharge of water used for onshore operations. Water is pumped directly from Drakes Estero and used for two purposes: establishing a controlled environment to seed larval shellfish and spray-washing harvested shellfish. Water for seeding shellfish larvae is used at two onshore stations: the indoor microcultch station and the outdoor cluster setting tanks. Drakes Estero water is circulated through these two stations and returned to Drakes Estero (see chapter 2) via underground PVC pipes that emerge in the intertidal zone where the water is released back into Drakes Estero. Water used to spray-wash harvested shellfish at the conveyor station is allowed to flow across the ground surface and reenters Drakes Estero. Drakes Estero water used for the indoor single-oyster cultch tanks is heated to a temperature of 23 to 25 degrees Celsius (73 to 77 degrees Fahrenheit) and enriched with nutrients (DBOC has not provided specifics as to which nutrients are added) to promote the growth of shellfish larvae. Water for the outdoor setting tanks is also heated and allowed to cool before re-entering Drakes Estero. Oysters in the setting tanks are fed by routing/circulating Drakes Estero water through the tanks on a continuous basis for several days. Because the original source of the water is Drakes Estero and the wastewater returning to Drakes Estero is relatively unchanged (with the exception of the small volume of nutrient-enriched water), these activities would be expected to have minor adverse effects on the water quality of Drakes Estero.

DBOC is proposing to remove the existing conveyor washing station and replace this facility with a new conveyor system that would capture the wastewater from the washing station and filter the water before the water is allowed to reenter Drakes Estero. This system would be expected to decrease the sediment loads entering Drakes Estero and local turbidity compared to the existing spraying system. This point-source discharge is not expected to significantly impact water quality (Baltan 2006).

DBOC operations would continue to use several wastewater septic tanks and pumps at the onshore facilities, as well as the two underground drain fields located upslope from the operations facility, until the year 2022. The capacity of the wastewater tanks, pumps, and drain fields appears to be sufficient to handle the effluent originating from the operations center. Thus, the risk of discharges from a lack of capacity appears unlikely. Impacts on water quality could occur from wastewater entering Drakes Estero if the treatment facility were to fail. Furthermore, maintenance of the wastewater treatment system would likely require that storage tanks be pumped as well as underground lines being cleaned/replaced. These actions could result in leaks and spillages of wastewater, causing small levels of wastewater (fecal coliform) to enter Drakes Estero. These levels, however, would not be expected to cause significant water quality impacts, to the degree that shellfish become contaminated or recreational use of Drakes Estero temporarily ceases. Water quality threats to Drakes Estero due to bacterial contamination (i.e., fecal coliform) from commercial shellfish operations would be minimal.

Vehicular traffic to and from the operations facility associated with the commercial shellfish operations is predicated on employee travel, distribution/delivery trucks, and visitors to the DBOC interpretations center. Vehicular use would continue under current conditions, resulting in oils and other pollutants entering Drakes Estero through nonpoint-source stormwater runoff originating from vehicles. NPS facilities would remain under this alternative.

As described above, alternative B would result in long-term minor adverse impacts on water quality for another 10 years because impacts would include temporary, localized impacts that would not have long-lasting effects on water quality (but would occur regularly) and would be within historical water quality conditions.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to water quality in Drakes Estero. Impacts to water quality associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact water quality within the project area. Actions that have the potential to combine with the impacts of Alternative B during the 10-year period of the new SUP include the existing fire management plan, coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), existing ranching operations, and moving the vault toilet away from the shoreline.

For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative B would result in a long-term minor adverse cumulative impact on water quality within Drakes Estero. Alternative B would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on water quality beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, this alternative would result in long-term minor adverse impacts on water quality for another 10 years. Alternative B would have recurring but not long-lasting effects on water quality and would be within historical water quality standards. Cultivated shellfish as filter feeders would remain in Drakes Estero under this alternative, offering localized long-term beneficial impacts to water quality by removing suspended solids, nutrients, and phytoplankton from the water column. Sediment disturbances from offshore mariculture activities (bags/trays, boats, wading DBOC employees) would be locally temporary (pulsing) and would dissipate after each tide cycle, resulting in short-term minor adverse impacts on water quality. Dredging around the floating dock would be expected to create temporary disturbances to the water column from increased turbidity. This action would cause short-term minor adverse impacts on water quality. The point-source discharges (washing station and setting tanks) under this alternative would continue, but no new point-source outputs would be introduced. Point-source discharges would include small amounts of marine sediments and fouling organisms removed at the washing station; no chemical contaminants would be discharged into Drakes Estero under this alternative. Non-point-source pollution from runoff is currently very small (less than 3 acres of impervious surface within a watershed

of several square miles). The cumulative impact would be long-term minor adverse, and alternative B would contribute a noticeable adverse increment to the cumulative impact.

With regards to water quality, alternative B would satisfy the goals and objectives of NPS *Management Policies 2006* (NPS 2006d) and would be consistent with the purpose of the CWA, which is to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.”

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact water quality are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC’s racks and bags would occupy the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any difference in impacts.

Impacts to water quality due to offshore operations would be the same as described under alternative B. Alternative C would continue the use of onshore buildings and operations with no appreciable difference compared to alternative B. Therefore, water quality impacts from onshore operations would be the same as those described under alternative B.

NPS facilities would remain under this alternative. Impacts on water quality from NPS facilities would be the same as described under alternatives A and B.

As described above, alternative C would result in long-term minor adverse impacts on water quality for another 10 years because impacts would include temporary, localized impacts that would not have long-lasting effects on water quality (but would occur regularly) and would be within historical water quality conditions.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to water quality in Drakes Estero. Impacts to water quality associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact water quality within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include the existing fire management plan, coastal watershed restoration projects within the Seashore (Geomorphologic Restoration Project and Drakes Estero Road Crossings Improvement Project), existing ranching operations, and moving the vault toilet away from the shoreline.

For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative C would result in a long-term minor adverse cumulative impact on water quality within Drakes Estero. Alternative C would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on water quality beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative C would result in long-term minor adverse impacts on water quality for another 10 years. Alternative C would have recurring but not long-lasting effects on water quality and would be within historical water quality standards. Cultivated shellfish would remain in Drakes Estero for another 10 years under this alternative, offering localized beneficial water filtering functions from the removal of suspended solids, nutrients, and phytoplankton from the water column. Impacts to water quality include those described under alternative B. In particular, sediment disturbances from offshore mariculture activities (bags/trays, boats, wading DBOC employees) would be locally temporary (pulsing) and would dissipate after each tide cycle, resulting in short-term minor adverse impacts on water quality. Dredging around the floating dock would be expected to create temporary disturbances to the water column from increased turbidity, resulting in short-term minor adverse impacts on water quality. Point-source discharges would include small amounts of marine sediments and fouling organisms removed at the washing station; no chemical contaminants would be discharged into Drakes Estero under this alternative. Nonpoint-source pollution from runoff is currently very small (less than 3 acres of impervious surface within a watershed of several square miles). The cumulative impact would be long-term minor adverse, and alternative C would contribute a noticeable adverse increment to the overall cumulative impacts.

With regards to water quality, alternative C would satisfy the goals and objectives of NPS *Management Policies 2006* (NPS 2006d) and would be consistent with the purpose of the CWA, which is to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.”

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact water quality are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact water quality include:

- Increased production limit
- New onshore development

Under alternative D, DBOC could produce up to 850,000 pounds of shellfish per year, which is a noteworthy increase of alternative B (600,000 pounds per year) and alternative C (500,000 pounds per year). If more cultivated shellfish are placed in Drakes Estero, this alternative would provide a higher level of localized water quality benefits as more shellfish filter and process pollutants from the water column. The higher production rate also would require more frequent boating trips to the offshore facilities, causing additional sediment disturbances from boat hulls, boat propellers, worker pedestrian access, and management of bags/trays compared to the other alternatives; however, these sediment disturbances would dissipate daily tidal flushing. Thus, impacts on water quality, while similar in their disturbance, are expected to be slightly higher than those described for alternatives B and C.

Onshore operations and water quality impacts would be nearly the same as those described under alternative B. One difference would be the replacement of the existing processing plant with a larger facility. This action is expected to cause temporary exposure of local soils during construction, potentially risking erosion and sediment transfer into Drakes Estero until construction is completed and soils are either stabilized on site or removed. Mitigating actions preventing sediment transfer may include installing silt fencing/hay bales along the wetland/waters shoreline. Construction of the new building may have short-term minor adverse impacts on water quality by increasing local turbidity levels and thus adversely affecting adjacent aquatic habitats for fish and shellfish. The building is not expected to increase impervious surface, affecting stormwater runoff pollution, because the building would be constructed on existing impervious area.

As described above, alternative D would result in long-term minor adverse impacts on water quality for another 10 years because impacts would include temporary, localized impacts that would not have long-lasting effects on water quality (but would occur regularly) and would be within historical water quality conditions. However, this alternative may cause slightly higher rates of sediment disturbance in Drakes Estero, compared to alternatives B and C, due to more frequent boat trips and bag/tray management. Alternative D also would result in short-term minor adverse impacts on water quality during construction of new DBOC facilities because impacts would include temporary (lasting less than a year), localized impacts that would not have long-lasting effects on water quality.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to water quality in Drakes Estero. Impacts to water quality associated with conversion of the site to congressionally designated wilderness in 2022 would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact water quality within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include the existing fire management plan, coastal watershed restoration projects within the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossings Improvement Project), existing ranching operations, and moving the vault toilet away from the shoreline. For the same reasons discussed in the cumulative impact analysis for alternative A, the impact of these past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts

of alternative D would result in a long-term minor adverse cumulative impact on water quality within Drakes Estero. Alternative D would contribute a noticeable adverse increment to the cumulative impact.

Due to the discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on water quality beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative D would have short-term minor adverse and long-term minor adverse impacts on water quality due to offshore and onshore activities associated with commercial shellfish operations within Drakes Estero. Alternative D would not be expected to exceed water quality standards, have long-lasting effects on water quality or impede the goals and objectives of NPS policies on water quality. Alternative D would have the highest population of cultivated shellfish occupying Drakes Estero. As a result, localized water quality benefits from filter feeding bivalves would be greatest compared to the other alternatives. The impacts associated with alternative D would be similar to those described under alternatives B and C. However, this alternative may cause slightly higher rates of sediment disturbance in Drakes Estero, compared to alternatives B and C, due to more frequent boat trips and bag/tray management. Onshore discharge into Drakes Estero of pumped water serving the washing station and setting tanks would be expected to add minor adverse impacts to water quality. In addition, onshore sediment may enter waters due to the construction of new facilities, although this action could be mitigated with the installation of silt fencing. Alternative D also would result in short-term minor adverse impacts on water quality during construction of new DBOC facilities because impacts would include temporary (lasting less than a year), localized impacts that would not have long-lasting effects on water quality. The cumulative impact would be long-term minor adverse, and alternative D would contribute a noticeable adverse increment to the cumulative impact.

With regards to water quality, alternative D would satisfy the goals and objectives of NPS *Management Policies 2006* (NPS 2006d) and would be consistent with the purpose of the CWA, which is to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.”

IMPACTS ON SOUNDSCAPES

LAWS AND POLICIES

The NPS Organic Act (16 USC section 1) establishes and authorizes NPS “to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” An important aspect of the natural communities that NPS is directed to preserve within the national park system is the natural soundscape, which enhances visitor experience and reduces disturbances of wildlife.

The Code of Federal Regulations recognizes concerns for preserving natural soundscapes; 36 CFR 2.12 (Audio Disturbances) restricts the use of certain types of power equipment in units of the park system and places sound level limitations on others. Noise levels that exceed 60 dB at 50 feet from the source, noise that

is unreasonable given the location or time of day, and noise that is not in keeping with the purpose for which the area was established are conditions that are usually inappropriate or excessive. Section 2.12(c) contains an exception allowing for the use of motorboats in areas where they are permitted. However, NPS does not allow the use of motorboats by the public in Drakes Estero because of its wilderness designation. Existing authorizations allow DBOC to use motorboats as part of its commercial shellfish operation.

NPS *Management Policies 2006*, section 4.9, “Soundscape Management,” requires that NPS “preserve, to the greatest extent possible, the natural soundscapes of parks.” Additionally, NPS “will restore to the natural condition wherever possible those park soundscapes that have become degraded by the unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts” (NPS 2006d).

Director’s Order 47: *Soundscape Preservation and Noise Management* was developed to emphasize NPS policies “that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources.” This Director’s Order also directs park managers to measure acoustic conditions, differentiate existing or proposed human-made sounds that are consistent with park purposes, set acoustic goals based on the sounds deemed consistent with the park purpose, and determine which noise sources are impacting the parks (NPS 2000).

Additionally, NPS *Management Policies 2006*, section 8.2.3, “Use of Motorized Equipment,” acknowledges that motorized equipment operating in national parks could adversely impact the park’s natural soundscape. To preserve the natural soundscape, park superintendents will manage when and where motorized equipment is used, evaluating effects on the natural soundscape against the natural ambient sound level (that which exists in the absence of human-induced sounds) (NPS 2006d).

METHODOLOGY

As described in chapter 3, the magnitude of noise is usually described by its sound pressure. Sound pressures described in decibels are often defined in terms of frequency-weighted scales. Sound levels measured using an A-weighted decibel scale are generally expressed as dBA. Throughout this section, all noise levels are expressed in dBA.

Impacts on soundscapes are judged primarily by the contribution of human-caused sound to the natural soundscape, based on the assumptions developed in chapter 3, which describes the affected environment. Assumptions include the following:

- The daytime median sound energy level on a bluff on the eastern shore of Drakes Estero is 34 dBA (Volpe 2011). This sound level incorporates human-caused noise and may be an overstatement of the natural soundscape; however, it will serve as a proxy for the natural soundscape.
- The sound energy contributed by DBOC activities are summarized in table 3-3
 - Two boats, together operating up to eight hours per day with approximately one passby per hour emit sound energy at a level of 71 dBA at 50 feet for each passby (DBOC [Lunny], pers. comm., 2011h; Noise Unlimited, Inc. 1995)

- A forklift (operating two to four hours a day) emits sound energy at a level of 79 dBA at 50 feet (DBOC [Lunny], pers. comm., 2011h; FHWA 2006)
- Pneumatic drills (operating approximately two hours per day) emit sound energy at a level of 85 dBA at 50 feet (DBOC [Lunny], pers. comm., 2011h; FHWA 2006)
- An oyster tumbler (operating approximately two hours per day) emits sound energy at a level of 79 dBA at 50 feet (DBOC [Lunny], pers. comm., 2011h; FHWA 2006)

Intensity Definitions

Intensity definitions for noise levels are rendered in terms of speech interference in order to interpret decibel values in relation to familiar, everyday experiences for park visitors and public stakeholders. As a point of reference, when the sound level is 40 dBA, vocal communication is difficult between people separated by 32 feet. These definitions are also meant to serve as a reasonable qualitative proxy for the magnitude of human-caused noise inference with animal behavior. For short-term impacts, percentages are based on the percentage of time during a year (taking into consideration 24 hours a day) that human-made noise impacts the ambient soundscape. For long-term impacts, percentages are based on the percentage of time during the 10-year SUP term (taking into consideration 24 hours a day) that human-made noise impacts the ambient soundscape. A 24-hour day is used because the soundscape exists and is impacted independent from wildlife or human experiences. Daytime and nighttime hours are treated the same in this analysis of the physical resource – the acoustical environment or soundscape– because background sound levels and sound propagation conditions do not vary substantially between day and night. The importance of daily and seasonal patterns of noise exposure on wildlife and humans is addressed elsewhere, in the discussion of “Impacts on Wildlife and Wildlife Habitat” and “Impacts on Visitor Experience and Recreation.”

Minor:	Human-caused noise would be at a level that causes vocal communication to be difficult between people separated by more than 32 feet, and the natural soundscape is interfered with less than 5 percent of the time.
Moderate:	Human-caused noise would be at a level that causes vocal communication to be difficult between people separated by 32 to 16 feet, and the natural soundscape is interfered with 5 to 10 percent of the time.
Major:	Human-caused noise would be at a level that causes vocal communication to be difficult between people separated by less than 16 feet, and the natural soundscape is interfered with more than 10 percent of the time.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Cessation of DBOC operations would include cessation of all DBOC actions that contribute human-caused noise from Drakes Estero following the expiration of the existing authorizations on November 30, 2012. According to the assumptions outlined in the methodology above and described in chapter 3, boats in Drakes Estero emit 71 dBA at 50 feet (Noise Unlimited, Inc. 1995) and the loudest noise at the onshore facilities is the pneumatic drill, at 85 dBA at 50 feet (FHWA 2006). Cessation of DBOC-related contributions of noise to the natural soundscape would remove the primary source of human-caused noise within the project area. Instead of needing to raise their voices or even shout to be heard, people would be able to communicate with each other in a normal speaking voice at distances of 16 feet or greater. Sounds associated with kayakers would persist, as discussed under cumulative impacts.

Impacts on wildlife due to alterations in the natural soundscape that have resulted from the commercial shellfish operation would be eliminated. Acoustical ecology in Drakes Estero would be restored to a condition primarily driven by natural processes. Just as people would be able to speak to each other more easily, interference with auditory cues for hunting, predator awareness, sexual communication, defense of territory, and habitat quality assessment emanating from the commercial shellfish operations would be eliminated (Barber, Crooks, and Fristrup 2010). Flushing of birds and harbor seals due to human-caused sounds would be greatly reduced. Any continued human-caused noise that may impact wildlife would be related to recreational boaters using kayaks or other nonmotorized watercraft, as well as infrequent use of motorboats by NPS staff for management purposes. Use of motorboats by NPS is strictly regulated through the Wilderness Act minimum requirement process. Visitor use of motorboats within Drakes Estero is prohibited, and Drakes Estero would continue to be closed to the public boating during harbor seal pupping season.

In addition to benefiting wildlife, restoration of the natural soundscape would enhance wilderness values by reducing the evidence of human activity within congressionally designated potential wilderness (which would be converted to congressionally designated wilderness under this alternative), and visitors seeking to experience the wilderness characteristics of Drakes Estero would have an improved experience.

Removal of DBOC property and structures may require the temporary use of heavy vehicles onshore and motorized use offshore, which typically emit sound levels between 60 and 80 dBA, depending upon which equipment is necessary (FHWA 2006). Use of such equipment is expected to last less than two months, assuming six days per week, 8 hours per day. Use of such equipment would compromise vocal communication to the point that speaking would be difficult between 2 and 6 feet. This would be a temporary impact on the natural soundscape while these activities occurred. However, the long-term impact would be beneficial due to the cessation of DBOC operations and manmade noise associated with the operation. This would result in the restoration of the natural soundscape within the project area. As described above, alternative A would result in short-term minor adverse impacts and long-term beneficial impacts on soundscapes. Cessation of the commercial shellfish operation under Alternative A would result in long-term beneficial impacts on soundscapes and the restoration of a substantially more natural soundscape. These beneficial impacts would result from the elimination in human-caused noise levels associated with the commercial shellfish operation. Short-term minor adverse impacts would result from the use of heavy machinery and motorized boats during removal of DBOC property and structures.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact soundscapes within the project area. These actions include restoration of the developed onshore area, kayak use, planning and management activities, and other sources of human-caused noise. Restoration of the developed onshore area may require use of heavy vehicles, which would contribute human-caused noise to the project area; however, this impact would be short-term (lasting less than a year). These actions have the potential for short-term minor to moderate adverse impacts on soundscapes.

Planning and management activities may call for actions that require motorboat use within Drakes Estero for research or administrative purposes. Motorboat use within Drakes Estero would continue to be subject to the minimum requirement because of the wilderness designation. Therefore, research activities within Drakes Estero are not expected to result in long-term alteration in the natural soundscape. Any noticeable contributions of human-caused noise would be temporary. This action has the potential for short-term minor adverse impacts on soundscapes.

Use of Drakes Estero by kayakers would continue to take place and may even increase following the removal of DBOC facilities. Noise produced by kayakers is limited to sounds such as talking, laughing, and shouting. Other sources of human-caused noise include airplane overflights and vehicles on Sir Francis Drake Blvd. These uses, even if increased, would contribute a long-term minor adverse impact on soundscapes.

The impacts of these past, present, and reasonably foreseeable future actions would be short-term minor to moderate adverse and long-term minor adverse. The impacts of these past, present, and reasonably foreseeable future actions, combined with the short-term minor to moderate adverse and long-term beneficial impacts of alternative A would result in a long-term beneficial cumulative impact on soundscapes. Alternative A would contribute an appreciable beneficial increment to the cumulative impact.

Conclusion

Alternative A would result in long-term beneficial impacts due to the elimination of human-caused noise levels associated with the commercial shellfish operation. Alternative A would also result in adverse impacts to soundscapes because the noise associated with the use of heavy machinery and motorized boats to remove DBOC structures and property would be at a level that would cause vocal communication to be difficult at a distance of less than 16 feet. However, this impact would interfere with the natural soundscape for less than 5 percent of one year; therefore, Alternative A would result in short-term minor to moderate adverse impacts on soundscapes. The cumulative impact would be long-term beneficial, and alternative A would contribute an appreciable beneficial increment to the cumulative impact.

With regard to soundscapes, alternative A would further the goals for soundscape management as set forth in relevant law and policy. NPS *Management Policies 2006* and *Director's Order 47: Soundscape Preservation and Noise Management* direct NPS managers to preserve and restore the natural soundscape, where possible.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact soundscapes include:

- Continued use of noise-generating onshore equipment
- Continued boat traffic

Offshore noise-generating operations would include continued motorboat traffic in Drakes Estero. The two motorboats together run up to 8 hours (or 12 40-minute trips) per day, six days a week. According to DBOC, boats travel to a site, are shut off while DBOC staff work, and are turned back on for travel to the next site. DBOC estimates that the motors are running for about a quarter of the time that the boat is being used in Drakes Estero (DBOC [Lunny], pers. comm., 2011h). According to this assumption, motorboat use impacts the natural soundscape for an intermittent two hours a day. The estimated sound energy generated by these boats is 71 dBA at 50 feet for each passby (Noise Unlimited, Inc. 1995). For a few minutes during the passby, a kayaker (or other receptor) that was within 50 feet of the boat, would experience a sound level of 37 dBA; this is more than the 34 dBA median daytime sound energy measured at a nearby site (Volpe 2011). This equates to a kayaker (or other receptor) experiencing a sound level that is 2-fold greater than the limit specified by NPS regulation (that is, 60 dBA at 50 feet). It also equates to more than 12 sources of noise emitting sound at the limit specified by NPS regulation.

Additionally, a forklift (operating two to four hours a day) and an oyster tumbler (operating approximately two hours per day) both emit sound energy at a level of 79 dBA at 50 feet (DBOC [Lunny], pers. comm., 2011h; FHWA 2006). Pneumatic drills (operating approximately two hours per day) emit sound energy at a level of 85 dBA at 50 feet (DBOC [Lunny], pers. comm., 2011h; FHWA 2006). The sound emitted by the pneumatic drill equates to more than 316 sources of noise emitting sound at the limit specified by NPS regulation.

It is unknown how much each noise source described above overlaps (i.e., whether or not they are operated at the same time or not); therefore, this analysis assumes a range of four to eight hours of noise generation occurs each day, six days per week. By this assumption, 24 to 48 hours of noise generation occur each week. In other words, DBOC contributes human-caused noise to the project area soundscape approximately 14 to 29 percent of the time. The areas and intensities of this impact vary as described below.

Figure 4-1 depicts a sample point to show how sounds would dissipate from a boat at four different locations in Drakes Estero. Figure 4-2 shows how sounds would dissipate from a pneumatic drill operating on the dock at the onshore facilities. Two noise contour levels were selected for these maps. The first (orange) represents the area receiving noise energy that is ten times the background sound level. Within this contour, noise dominates the acoustical environment and reduces the effective listening area for other sounds in the same frequency band by 90 percent. Sound levels are estimated to be at least 47 dBA. The outer contour (yellow) represents the area in which the received noise level equals the background environmental level. Within this contour, the sum of the noise and background levels results

in a level at least 3 dBA above the background level. Noise in this area is prominent, and the effective listening area for other sounds occupying the same frequency band will be reduced by 50 percent.

A sample of how motorboat sound would be dissipated over water on a calm day is displayed in table 4-2 below. These distances assume spherical spreading loss and nominal atmospheric absorption value for the noise (400 hertz [Hz], 59 degrees Fahrenheit, 50 percent humidity). They will underestimate the range that the noise propagates when a near surface inversion layer exists, and if most of the noise energy lies below 400 Hz. According to weather conditions recorded at the closest weather station to the project area (the Point Reyes Light Station) over the course of the past year, approximately 34 percent of days experienced an average wind speed of less than 10 miles per hour (Western Regional Climate Center 2011). On windy days, the natural condition sound levels would be higher and the motorboat sound may dissipate more quickly upwind but would carry further downwind.

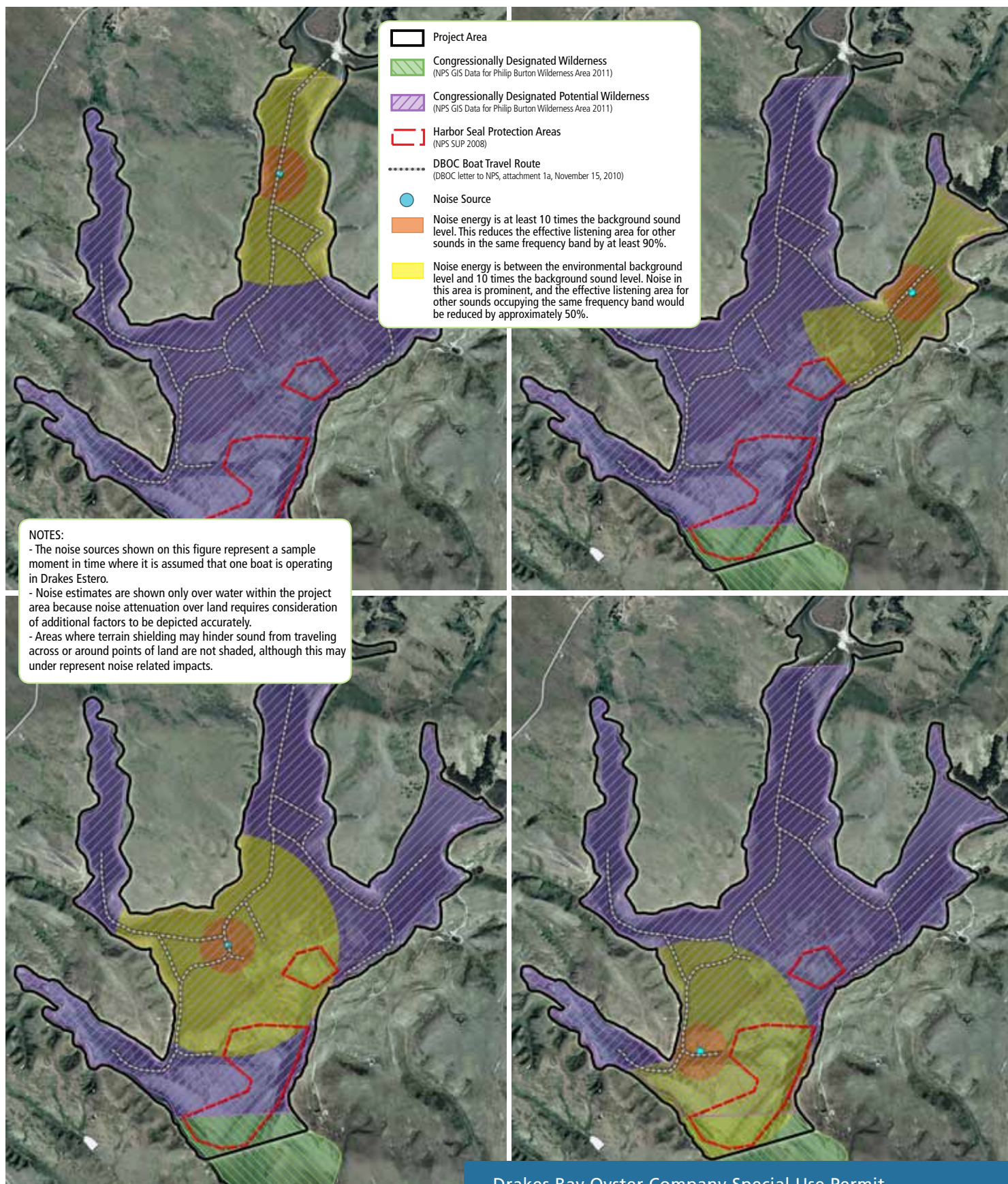
Table 4-2 demonstrates that DBOC's continued use of motorboats within Drakes Estero would result in an increase in sound pressure of up to 37 dBA compared to the natural soundscape. In other words, within 50 feet of the source, vocal communication would be difficult if people are more than 4 feet away from each other (EPA 1981). Table 4-2 shows that it would take a distance of approximately 2,658 feet for the noise level from motorboats to reach the lowest daily median ambient sound levels measured during a recent study (Volpe 2011).

TABLE 4-2. ESTIMATED MOTORBOAT SOUND DISSIPATION

Distance from Motorboat (feet)	Sound Energy (dBA)	Functional Consequence*
50	71	Vocal communication will be difficult at more than 4 feet ¹
435	52	Interferes with interpretive presentations or group leader communication ¹
1,048	44	Noise exceeds the median ambient sound level from the highest daily ambient level measured.
2,658	35	Background sound levels exceed desired levels for classrooms, bedrooms, auditoria, and other indoor spaces where quiet and good listening conditions are important. ²
7,062	24	Noise exceeds the median ambient sound level from the lowest daily ambient level measured.

Sources: ¹EPA 1981, ²ANSI 2008

*Metrics are included for ease of comparison



Drakes Bay Oyster Company Special Use Permit Environmental Impact Statement

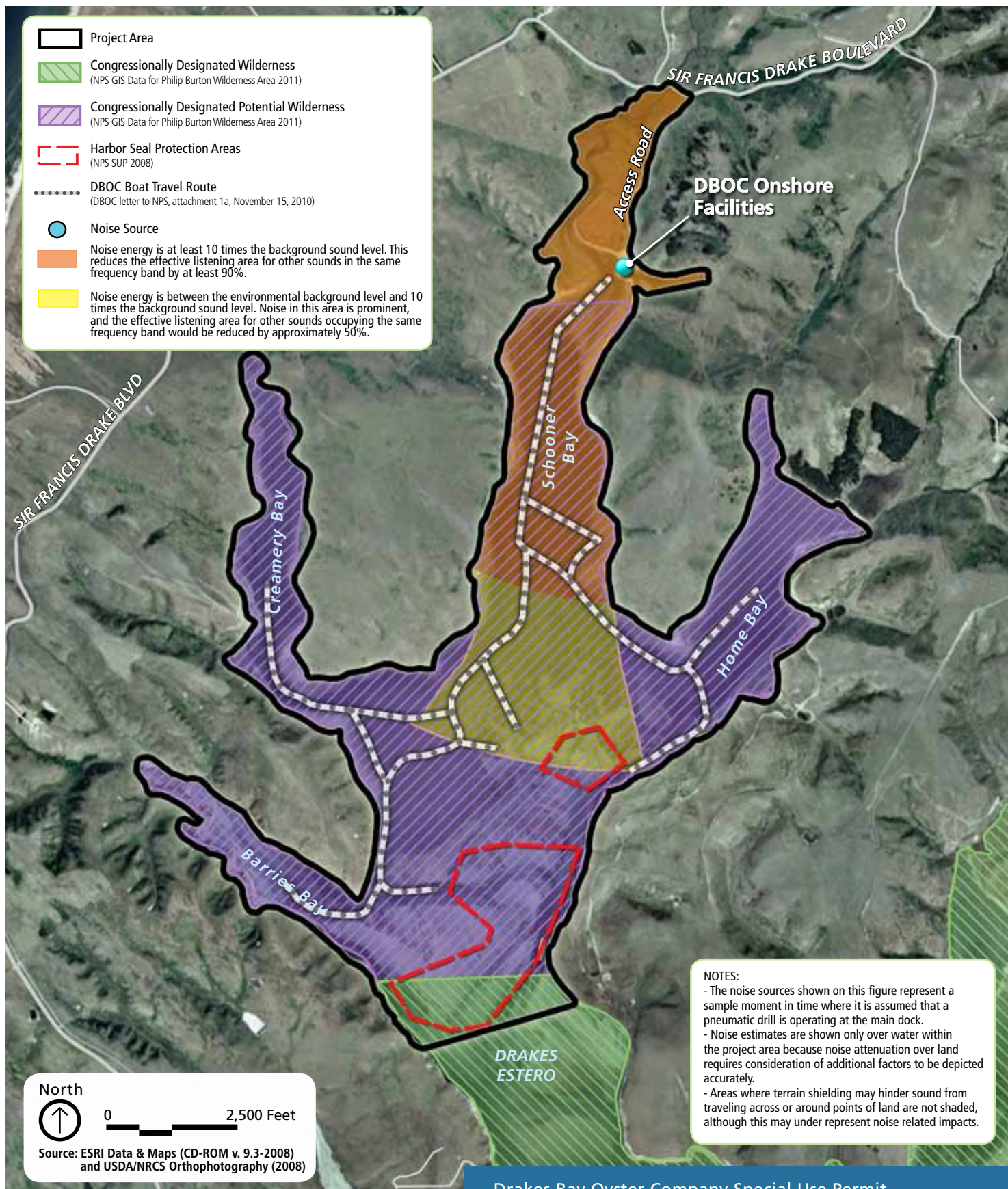


National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 4-1

DBOC Noise Generation - Offshore Facilities



Drakes Bay Oyster Company Special Use Permit Environmental Impact Statement

FIGURE 4-2

DBOC Noise Generation - Onshore Facilities



National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

Onshore sources of noise and their dissipation over the waters of Drakes Estero are summarized in tables 4-3 and 4-4. Under calm conditions, the sounds from onshore operations would dissipate to the lowest daily median ambient sound levels measured within approximately 12,450 to 17,650 feet (2.4 to 3.3 miles) from the source, depending on which equipment is operating. See figure 4-2 for a visualization of sound emitted by a pneumatic drill at the DBOC main dock.

TABLE 4-3. ESTIMATED FORKLIFT AND OYSTER TUMBLER SOUND DISSIPATION

Distance from Forklift or Oyster Tumbler (feet)	Sound Energy (dBA)	Functional Consequence*
50	79	Vocal communication will be difficult at more than 2 feet ¹
1,048	52	Interferes with interpretive presentations or group leader communication ¹
2,408	44	Noise exceeds the median ambient sound level from the highest daily ambient level measured.
5,529	35	Background sound levels exceed desired levels for classrooms, bedrooms, auditoria, and other indoor spaces where quiet and good listening conditions are important. ²
12,450	24	Noise exceeds the median ambient sound level from the lowest daily ambient level measured.

Sources: ¹EPA 1981, ²ANSI 2008

*Metrics are included for ease of comparison

TABLE 4-4. ESTIMATED PNEUMATIC DRILL SOUND DISSIPATION

Distance from Pneumatic Drill (feet)	Sound Energy (dBA)	Functional Consequence*
50	85	Vocal communication will be difficult at more than 5 feet ¹
1,969	52	Interferes with interpretive presentations or group leader communication ¹
4,256	44	Noise exceeds the median ambient sound level from the highest daily ambient level measured.
8,862	35	Background sound levels exceed desired levels for classrooms, bedrooms, auditoria, and other indoor spaces where quiet and good listening conditions are important. ²
17,650	24	Noise exceeds the median ambient sound level from the lowest daily ambient level measured.

Sources: ¹EPA 1981, ²ANSI 2008

*Metrics are included for ease of comparison

Contribution of human-caused noise to the natural soundscape has the potential to impact use of the project area by wildlife as well as visitors. It also has the potential to impact the wilderness characteristics of Drakes Estero. Wilderness areas are valuable for their untrammeled, natural, and undeveloped characteristics as well as for the opportunity for solitude and a primitive or unconfined form of recreation (as described in more detail in the wilderness impact topic). The noise from DBOC operations detracts from these values. Onshore operations are approximately 670 feet north of the northern boundary of congressionally designated potential wilderness within Drakes Estero; however, the measurements estimated in tables 4-3 and 4-4 show that sounds from onshore operations have the potential to contribute highly noticeable sounds within the wilderness area. The sounds serve as evidence of human intrusion on

the natural landscape and disrupt opportunities for solitude. During public scoping, some commenters described the noise generated by DBOC as unpleasant. The percent time that the soundscape is impacted by shellfish operation noise stated earlier (14 to 29 percent) is based on a 24 hour day despite the fact that noise generation takes place during the day. Visitors are allowed to use the kayak parking lot from 6 a.m. to 12 midnight daily. When the same impacts described above are applied to an 18 hour day, percent time impacted increases. Approximately 19 to 38 percent of time that the site is open to visitor use is impacted by shellfish operation noise.

Relatively high noise levels in the project area also would have impacts on wildlife and wildlife habitat. As mentioned previously, the A-rated decibel scale reflects the frequency range to which the human ear is most sensitive (1 to 5 kHz). The hearing ranges of harbor seals and birds are similar. Harbor seals have a high range of sound sensitivity in water (1 to 180 kHz); however, in the air, harbor seal hearing is similar to that of humans (1 to 22.5 kHz), although still sensitive through a greater range of frequencies (Ridgway 1972). Birdsong also generally falls into this range (Barber, Crooks, and Fristrup 2010). Therefore, although each species (including humans) hears differently, the dBA scale is a reasonable representation of sound pressure emitted by noise generators and the level of disturbance that can be expected. Wildlife is very sensitive to sound, as animals often depend on auditory cues for hunting, predator awareness, sexual communication, defense of territory, and habitat quality assessment (Barber, Crooks, and Fristrup 2010). Negative population-level, behavioral, and habitat-use consequences of higher ambient sound levels from human voices, along with sound events associated with human activities (motorists, hikers), have been observed in many species (Frid and Dill 2002; Habib, Bayne, and Boutin 2007). Human activities can disturb harbor seals at haul-out sites, causing changes in harbor seal abundance, distribution, and behavior, and can even cause abandonment (Suryan and Harvey 1999; Grigg et al. 2002; Seuront and Prinzivalli 2005; Johnson and Acevedo-Gutierrez 2007). Under alternative B, DBOC operations would continue to cause disturbances related to impacts on the soundscape within the project area. Similar to visitor use, the overall soundscape percent of time impacted understates impacts to diurnal animals (i.e., animals that are active during the day).

Finally, demolition of the damaged main dock and construction of the proposed dock would require the temporary use (less than one month assuming six days per week, 8 hours per day) of heavy vehicles, which typically emit sound levels between 60 and 80 dBA, depending on which equipment is necessary (FHWA 2006). This would cause a temporary adverse impact on the natural soundscape.

Based on the information above, issuance of a 10-year SUP under alternative B would result in short-term minor and long-term major adverse impacts on soundscapes. Short-term minor adverse impacts on soundscapes would result from the use of heavy machinery during replacement of the main dock, work platform, and associated structures. Alternative B would result in continued long-term major adverse impacts on soundscapes due to the operation of boats and other onshore machinery.

Upon expiration of the SUP in 2022, DBOC operations would cease and NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts to soundscapes in the project area. The man-made noise associated with the offshore and onshore operations of DBOC would cease in 2022 and impacts to soundscapes would, at that point in time, be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact soundscapes within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include kayak use, planning and management activities, and human-caused noise (other than DBOC), as described under alternative A. The impacts of these past, present and reasonably foreseeable future actions would be long-term minor adverse. The impacts of these past, present, and reasonably foreseeable future actions, when combined with the short-term minor and long-term major adverse impacts of alternative B would result in a long-term major adverse cumulative impact on soundscapes. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts to soundscapes beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative B would result in short-term minor and long-term major adverse impacts on soundscapes. Short-term minor adverse impacts on the natural soundscape would result from the use of heavy machinery during replacement of the main dock, work platform, and associated structures. The use of heavy machinery would be at a level that would cause vocal communication to be difficult at distances of less than 16 feet. However, this impact would interfere with the natural soundscape for less than 5 percent of one year; therefore, alternative B would result in short-term minor adverse impacts to the natural soundscape. Alternative B would also result in continued long-term major adverse impacts on the natural soundscape due to the operation of boats and other onshore machinery that would be at a level that would cause vocal communication to be difficult at distances of less than 16 feet. This impact would interfere with the natural soundscape between 14 and 29 percent of the time over the 10-year SUP term; therefore, alternative B would result in long-term major adverse impacts on the natural soundscape. The cumulative impact would be long-term major adverse, and alternative B would contribute an appreciable increment to the cumulative impact.

With regard to soundscapes, alternative B would not further the goals for soundscape management as set forth in relevant law and policy. For instance, *NPS Management Policies 2006* (NPS 2006d) directs park managers to take steps to restore and maintain natural soundscapes, whereas alternative B would include continued impacts to the natural soundscape from DBOC activities. This aspect of Alternative B would also be inconsistent with 36 CFR 2.12 because it would allow DBOC to continue to use several mechanical tools that emit noise over 60 dBA at 50 feet. In addition to DBOC trucks, pneumatic drill, and oyster tumbler operating onshore, DBOC would continue to operate its motorboats in potential wilderness, where motorboats are not allowed (except for those used occasionally by NPS for administration of the wilderness in accordance with a minimum requirements analysis). Contributions of human-caused noise to the natural soundscape are also a detriment to wilderness values, as described in more detail under that impact topic.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact soundscapes are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC's racks and bags would occupy the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any difference in impacts.

The resulting contribution of sound at increasing distances from the source for each major contributor is summarized in tables 4-2 through 4-4. The differences in lease boundaries, cultivated species, and production limits under alternative C would not change the impacts in soundscapes described for alternative B.

Based on the information above, issuance of a 10-year SUP under alternative C would result in long-term major adverse impacts on soundscapes due to the operation of boats and other onshore machinery. Alternative C also would result in short-term minor adverse impacts on soundscapes due to the use of heavy machinery during replacement of the main dock, work platform, and associated structures.

Upon expiration of the SUP in 2022, DBOC operations would cease and NPS would convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. These actions would result in changes in impacts to soundscapes in the project area. The man-made noise associated with the offshore and onshore operations of DBOC would cease and at that point in time, impacts to soundscapes would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact soundscapes within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include kayak use, planning and management activities, and sources of human-caused noise (other than DBOC), as described under alternative A. The impacts of these past, present and reasonably foreseeable future actions would be long-term minor adverse. The impacts of these past, present, and reasonably foreseeable future actions, when combined with the short-term minor and long-term major adverse impacts of alternative C, would result in a long-term major adverse cumulative impact on soundscapes. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Due to the discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts on soundscapes beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative C would result in short-term minor and long-term major adverse impacts on soundscapes. Short-term minor adverse impacts on soundscapes would result from the use of heavy machinery during replacement of the main dock, work platform, and associated structures. The use of heavy machinery would be at a level that would cause vocal communication to be difficult at distances of less than 16 feet. However, this impact would interfere with the natural soundscape for less than 5 percent of one year; therefore, alternative C would result in short-term minor adverse impacts to the natural soundscape. Alternative C would also result in continued long-term major adverse impacts on the natural soundscape due to the operation of boats and other onshore machinery that would be at a level that would cause vocal communication to be difficult at distances of less than 16 feet. This impact would interfere with the natural soundscape between 14 and 29 percent of the time; therefore, alternative C would result in long-term major adverse impacts on the natural soundscape. The cumulative impact would be long-term major adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

With regard to soundscapes, alternative C would not further the goals for soundscape management as set forth in relevant law and policy. For instance, NPS *Management Policies 2006* (NPS 2006d) directs park managers to take steps to restore and maintain natural soundscapes, whereas alternative C would include continued impacts to the natural soundscape from DBOC activities. This aspect of alternative C would also be inconsistent with 36 CFR 2.12 because it would allow DBOC to continue to use several mechanical tools that emit noise over 60 dBA at 50 feet. In addition to DBOC trucks, pneumatic drill, and oyster tumbler operating onshore, DBOC would continue to operate its motorboats in potential wilderness, where motorboats are not allowed (except for those used occasionally by NPS for administration of the wilderness in accordance with a minimum requirements analysis). Contributions of human-caused noise to the natural soundscape are also a detriment to wilderness values, as described in more detail under that impact topic.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for continued commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact soundscapes are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact soundscapes include:

- Increased production limit
- New onshore development

Under alternative D, impacts on soundscapes have the potential to be greater than under alternatives B and C. Under alternative D, DBOC could produce up to 850,000 pounds of shellfish per year, which is a noteworthy increase over alternatives B (600,000 pounds per year) and C (500,000 pounds per year). This could result in increased operation of the noise-generating equipment described under alternative B.

DBOC would operate the same noise-generating equipment described under alternative B. The resulting contribution of sound at increasing distances from the source for each contributor is summarized in tables 4-2 through 4-4. The increase in production limit may increase the frequency of natural soundscape disturbance by DBOC operations when compared to the disruptions described for alternatives B and C due to the potential for increased frequency of noise-generating activities such as boat trips and operation of drills and other machinery.

Additionally, under alternative D, there would be some level of demolition of existing structures and construction of new structures within the onshore permit boundaries. The activities associated with this development, such as use of heavy machinery, would cause short-term but highly noticeable impacts on the natural soundscape. Activities associated with demolition and construction could take place over several months, assuming six days per week, 8 hours per day.

As described above, alternative D would result in long-term major adverse impacts on soundscapes due to the operation of boats and other machinery. Alternative D would also result in short-term moderate adverse impacts on the natural soundscape due to the use of heavy machinery during development of additional onshore facilities.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to soundscapes in Drakes Estero. The man-made noise associated with the offshore and onshore operations of DBOC would cease and impacts to soundscapes would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact soundscapes within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include kayak use, planning and management activities, and sources of human-caused noise (other than DBOC), as described under alternative A. The impacts of these past, present and reasonably foreseeable future actions would be long-term minor adverse. The impacts of these past, present, and reasonably foreseeable future actions, when combined with the short-term moderate and long-term major adverse impacts of alternative D, would result in a long-term major adverse cumulative impact on soundscapes. Alternative D would contribute an appreciable adverse increment to the cumulative impacts.

Due to the discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A.

Conclusion

Overall, alternative D would result in short-term moderate and long-term major adverse impacts on soundscapes. Alternative D would result in short-term moderate adverse impacts on soundscapes due to the use of heavy machinery during the construction of additional onshore facilities. The use of heavy

machinery would be at a level that would cause vocal communication to be difficult at distances of less than 16 feet. However, this impact would interfere with the natural soundscape for between 5 and 10 percent of one year, therefore alternative D would result in short-term moderate adverse impacts to the natural soundscape. The operation of boats and other onshore machinery for an additional 10 years would result in long-term major adverse impacts. Impacts would be at a level that would cause vocal communication to be difficult at distances of less than 16 feet and would interfere with the natural soundscape between 14 and 29 percent of the time. The cumulative impact on soundscapes would be long-term major adverse, and alternative D would contribute an appreciable adverse increment to the cumulative impact.

With regard to soundscapes, alternative D would not further the goals for soundscape management as set forth in relevant law and policy. For instance, NPS *Management Policies 2006* (NPS 2006d) directs park managers to take steps to restore and maintain natural soundscapes, whereas alternative D would include continued impacts to the natural soundscape from DBOC activities. This aspect of Alternative D would also be inconsistent with 36 CFR 2.12 because it would allow DBOC to continue to use several mechanical tools that emit noise over 60 dBA at 50 feet. In addition to DBOC trucks, pneumatic drill, and oyster tumbler operating onshore, DBOC would continue to operate its motorboats in potential wilderness, where motorboats are not allowed (except for those used occasionally by NPS for administration of the wilderness in accordance with a minimum requirements analysis). Contributions of human-caused noise to the natural soundscape are also a detriment to wilderness values, as described in more detail under that impact topic.

IMPACTS ON WILDERNESS

LAWS AND POLICIES

The Wilderness Act was passed in 1964. The Act established the National Wilderness Preservation System (NWPS) to permanently protect some of the most natural and undisturbed places in the United States and to serve as the guiding piece of legislation for all wilderness areas “in order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition” (PL 88-577, section 2a). Through the act, Congress announced its intent to preserve and protect wilderness areas in their natural condition.

The National Wilderness Preservation System is a nationwide system of wilderness areas. This system currently contains over 700 wilderness areas in 44 of 50 states, and comprises over 107 million acres, ranging from the Aleutian Islands Wilderness in Alaska to the Death Valley Wilderness in Nevada and the Shenandoah Wilderness in Virginia (Wilderness.net 2011).

In 1976, Congress established more than 33,000 acres of wilderness within Point Reyes National Seashore (PL 94-544 and 94-567). This area is known as the Phillip Burton Wilderness Area (PL 99-68). The Philip Burton Wilderness Area is unique in that it is the only wilderness area between Canada and Mexico that includes marine waters (wilderness.net 2011). Of the 33,000 acres, 25,370 were designated as wilderness and 8,003 acres, including the entirety of Drakes Estero, were designated as *potential*

wilderness. Potential wilderness refers to areas where temporary nonconforming uses preclude congressional wilderness designation. The only nonconforming use in Drakes Estero is DBOC's commercial shellfish operation. Public Law 94-567 created an administrative mechanism allowing NPS to convert the potential wilderness areas in Drakes Estero to full wilderness status once this nonconforming use is removed. When the mariculture operation is removed, the potential wilderness will convert to full wilderness status upon publication by NPS of a notice in the Federal Register announcing the cessation of the nonconforming use.

Section 4(c) of the Wilderness Act identifies prohibited uses, otherwise known as nonconforming uses, in wilderness. Nonconforming uses include a prohibition on commercial enterprises, mechanized equipment such as motorboats, and manmade structures. DBOC's commercial shellfish operation, and its associated use of mechanized equipment and manmade infrastructure in the estero, constitutes a nonconforming use of wilderness.

With regard to nonconforming uses in potential wilderness in Point Reyes National Seashore, the House Committee Report accompanying the 1976 law stated:

As is well established, it is the intention that those lands and waters designated as potential wilderness additions will be essentially managed as wilderness, to the extent possible, with efforts to steadily continue to remove all obstacles to the eventual conversion of these lands and waters to wilderness status. (H. Rep. No. 94-160, September 24, 1976)

In 2004, the Solicitor's Office issued an opinion regarding the timing of the conversion of Drakes Estero from potential to congressionally designated wilderness status. Based on a review of the 1976 wilderness legislation, its legislative history, and the expiration date of the RUO, the Solicitor's Office concluded that NPS lacked discretion to continue the commercial shellfish operation beyond November 30, 2012 (DOI 2004). At that time, NPS notified CDFG of this information (NPS 2004d^{xvi}), and CDFG notified JOC (CDFG 2004a^{xvii}). The earliest date that the nonconforming use could be removed, thus allowing conversion to congressionally designated wilderness status, is November 30, 2012. Section 124 now provides discretionary authority for the Secretary to authorize DBOC's nonconforming use for an additional 10 years.

While a nonconforming use remains in potential wilderness, NPS *Management Policies 2006* requires that the potential wilderness be managed as wilderness to the extent that the existing nonconforming use allows (NPS 2006d). In addition, NPS *Management Policies 2006* states that NPS will engage the public as it determines the most appropriate means for removing from potential wilderness the nonconforming conditions that preclude wilderness designation (NPS 2006d, section 6.3.1). To this end, NPS *Management Policies 2006* requires that proposals having the potential to impact wilderness resources be evaluated in accordance with NPS procedures for implementing NEPA, and that NPS take into account the four essential qualities of wilderness, as outlined below (NPS 2006d, section 6.3.4.3). This EIS assists the Secretary in obtaining public input on the most appropriate means and timing of removing nonconforming uses that preclude wilderness designation from potential wilderness.

Any action proposed to take place within wilderness, such as research or park management, is subject to a minimum requirement analysis as described in the Minimum Requirements Decision Guide (developed

by the interagency Arthur Carhart National Wilderness Training Center) and NPS *Management Policies 2006* (NPS 2006d, section 6.3.5). This concept is applied as a two-step process that determines (1) whether or not the proposed action is appropriate or necessary for administration of the area as wilderness and does not cause significant impact on wilderness resources and character, in accordance with the Wilderness Act, and (2) the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized (NPS 2006d). DBOC operations are permitted separately and are therefore exempted from this analysis.

METHODOLOGY

The Interagency Wilderness Character Monitoring Team, which represents the Bureau of Land Management, USFWS, NPS, U.S. Geological Survey, and U.S. Forest Service, offers an interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System in the handbook *Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character across the National Wilderness Preservation System* (Landres et al. 2008). Based on the statutory language of the Wilderness Act, the interagency team identified four qualities of wilderness character that should be used in wilderness planning, stewardship, and monitoring:

- **Untrammeled**—Wilderness is essentially unhindered and free from modern human control or manipulation
- **Natural**—Wilderness ecological systems are substantially free from the effects of modern civilization
- **Undeveloped**—Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation
- **Solitude or a primitive and unconfined type of recreation**—Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation (Landres et al. 2008)

These four qualities are used in this EIS to evaluate the extent to which wilderness values are either preserved, restored, or diminished under each alternative.

Intensity Definitions

Minor:	Impacts on qualities of wilderness character would occur, but would be small and, if noticeable, would be highly localized.
Moderate:	Impacts on qualities of wilderness character would occur and would be measurable and readily apparent, but somewhat localized.
Major:	Impacts on qualities of wilderness character would occur and would be measurable, readily apparent, and widespread.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The presence of DBOC operations within Drakes Estero currently represents the only nonconforming structures and uses within the 1,363 acres of congressionally designated wilderness. Removal of these structures and uses by November 30, 2010 would allow NPS to convert Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness in 2012 under alternative A.

As described in the “Laws and Policies” section above, the four wilderness qualities can be summarized as untrammeled, natural, undeveloped, and providing opportunities for solitude or a primitive and unconfined type of recreation.

An area is “untrammeled” when it is essentially free from modern human control or manipulation (Landres et al. 2008). DBOC would remove bags, racks, and associated shellfish infrastructure from approximately 138 acres of Drakes Estero and would cease the use of motorboats within approximately 740 acres of Drakes Estero. These actions would result in removal of the human-made structures and motorized boat traffic, both of which currently impose human manipulation on natural processes. Following removal, biophysical processes such as sediment transport and nutrient cycling would be unhindered by human manipulation. By removing the uses and structures that currently manipulate the biophysical environment, alternative A would result in a noticeably more untrammeled environment. This would be a readily apparent, widespread improvement in wilderness character.

An area is “natural” when the ecological system is substantially free from the effects of modern civilization (Landres et al. 2008). The Wilderness Act section 2(a) states that wilderness should be free from the effects of “an increasing population, accompanied by expanding settlement and growing mechanization.” In other words, the desired state of wilderness is one in which native species composition, structures, and function of the wilderness area should be protected and allowed to take place free of planned intervention and modern civilization at the scale of the wilderness area (Landres et al. 2008).

The cessation of commercial shellfish operations would eliminate the most apparent effect of modern civilization from within Drakes Estero. DBOC would remove cultured shellfish and associated mariculture infrastructure and equipment from Drakes Estero, which would allow the ecosystem to regain a natural population of shellfish, eelgrass, and other ecosystem components, both biological and physical. The Pacific oyster, which is the primary species cultured by DBOC, is not native to California (Trimble, Ruesink, and Dumbauld 2009). Cultivation currently takes place in up to 138 acres of Drakes Estero. Over 6 million of the nonnative Pacific oysters (approximately 585,000 pounds) were harvested in 2010 (CDFG 2010a). Additionally, DBOC recently began cultivation of Manila clams and planted 1 million seeds in Drakes Estero in 2009 (CDFG 2009a). The Manila clam also is a nonnative species. Such

introductions have the potential to develop naturally breeding populations in Drakes Estero (NAS 2004, 2009). The introduction of commercially grown nonnative bivalve species carries a certain level of risk that the nonnative species would outcompete native bivalves, leading to a decrease in local biodiversity for native bivalve species (Ruesink et al. 2005; Trimble, Ruesink, and Dumbauld 2009; Dumbauld, Ruesink, and Rumrill 2009; NAS 2010). Thus far, one incidence of naturalized Manila clams has been observed within Drakes Estero (Grosholz 2011b). Under alternative A, cessation of DBOC operations would reduce the risk of active spread of naturalized species such as Manila clam, and the active distribution of the invasive tunicate *Didemnum* by DBOC actions would cease.

Historic importation of the Pacific oyster on cultch has resulted in the introduction of other nonnative species to the region (NAS 2009, 2010; Foss et al. 2007), such as the pathogen *Haplosporidium nelsoni* (MSX) (Friedman 1996; Burreson and Ford 2004), herpes-like viruses (Burge et al. 2005; Burge, Griffin, and Friedman 2006; Friedman 1996), and particularly the invasive colonial tunicate *Didemnum vexillum* (*Didemnum*) (Lambert 2009; Foss et al. 2007). As noted in NAS (2009), shellfish mariculture has introduced nonnative invasive species such as *Didemnum* into various habitats in Drakes Estero. The termination of DBOC activities would greatly reduce the potential for shellfish mariculture-related propagation of nonnative species such as colonial tunicates, which take advantage of the substrate created by the mariculture structures, and have recently been documented colonizing the leaf blades of eelgrass (Carman et al. 2009; Carman and Grunden 2010; Grosholz 2011b). Removal of the 7 acres of racks and all cultivated shellfish would reduce potential habitat for nonnative species. Nonnative species currently present in Drakes Estero may persist in the absence of commercial mariculture activities; however, future efforts at control would be more likely to be successful in the absence of continued introduction and/or distribution.

Current DBOC operations also impact eelgrass, fish, harbor seals, and birds, as described under those impact topics. Eelgrass damaged by motorboat use (approximately 8.5 miles of estimated damage within the approximately 740 acres used by boats) would have an opportunity to regenerate under this alternative and would no longer be shaded by 7 acres of racks. Restoration of eelgrass, a designated essential fish habitat, would indirectly benefit local fish communities by restoring a more natural distribution of fish species in Drakes Estero. The return of Drakes Estero to a more natural ecosystem would enhance the natural quality of the wilderness area.

Also, DBOC would no longer operate noise-generating equipment such as motorboats, pneumatic drills, the oyster tumbler, and onshore vehicles. Noise associated with commercial mariculture operations would no longer disturb wildlife within the project area. Sound travels well over water; therefore, noise dissipates at a rate of only 6 dBA per doubling of distance (FTA 2006). As discussed in greater detail under the impact topic of soundscapes, a motorboat in Drakes Estero produces a sound of 71 dBA at 50 feet (Noise Unlimited, Inc. 1995). On a calm day, it may take over 3,200 feet (0.6 miles) for this sound to dissipate to natural sound levels. Negative population-level, behavioral, and habitat-use consequences of higher ambient sound levels from human voices, along with sound events associated with human activities (motorists, hikers), have been observed in many species (Frid and Dill 2002; Habib, Bayne, and Boutin 2007). Human activities can disturb harbor seals at haul-out sites, causing changes in harbor seal abundance, distribution, and behavior, and can even cause abandonment (Suryan and Harvey 1999; Grigg et al. 2002; Seuront and Prinzivalli 2005; Johnson and Acevedo-Gutierrez 2007). Cessation of DBOC motorboat use would eliminate disturbance of wildlife related to DBOC operations.

Therefore, by removing the uses and structures that currently cause alterations to the natural ecosystem,

particularly with respect to introduction and perpetuation of large numbers of nonnative species, alternative A would result in a noticeably more natural environment. This would be a readily apparent, widespread improvement in wilderness character.

An area is “undeveloped” when it retains “its primeval character and influence, and without permanent improvements or human habitation,” with “the imprint of man’s work substantially unnoticeable” (section 2[c] of the Wilderness Act). For many of the same reasons mentioned above, cessation of DBOC operations and removal of DBOC motorboats and infrastructure would remove evidence of human occupation and allow natural processes to restore the “primeval character” and influence of Drakes Estero. Under alternative A, the “undeveloped” characteristics of Drakes Estero would be restored, resulting in a readily apparent, widespread improvement in wilderness character.

Lastly, wilderness areas provide “outstanding opportunities for solitude or primitive and unconfined recreation” (Landres et al. 2008). Removal of structures and motorboats in Drakes Estero would enhance opportunities for solitude within Drakes Estero, allowing visitors to enjoy a primitive and unconfined form of recreation. Many visitors kayak (or use other types of nonmotorized boats) within Drakes Estero. Under this alternative, opportunities for solitude and primitive recreation would no longer be interrupted by DBOC’s daily motorboat use (up to 12 trips per day, six days per week) or the visual disturbance to the natural scene associated with the presence of mariculture-related structures such as racks. Similarly, noise produced by onshore DBOC operations also has the potential to impact wilderness, despite the 670-foot distance between onshore facilities and the northern wilderness boundary, because of the potential for sounds to travel great distances over water, disrupting opportunities for solitude. Cessation of these operations would allow the sound level in the wilderness area to return to that of a predominantly natural soundscape.

Under alternative A, NPS would maintain the existing access road, kayak launch, parking lot, interpretive board, and vault toilet. All of these facilities are located outside wilderness. NPS would install a new gate to limit boat access to Drakes Estero during harbor seal pupping season. This would not cause a change in visitor use patterns because Drakes Estero is currently closed to recreational boating during the harbor seal pupping season. The maintenance of these facilities would support continued access by park visitors to the wilderness areas of Drakes Estero, except during harbor seal pupping season. For the reasons described above, opportunities for solitude and for primitive and unconfined recreation in Drakes Estero would be maintained and enhanced under alternative A. This would result in a readily apparent, widespread improvement in wilderness character.

NPS currently prohibits other park visitors from using mechanized boats and equipment within the congressionally designated potential wilderness areas in Drakes Estero. This prohibition is consistent with the Wilderness Act and NPS *Management Policies 2006*, which require NPS to manage potential wilderness as wilderness to the extent that existing nonconforming uses allow (NPS 2006d). DBOC’s commercial shellfish operation is the only nonconforming use in Drakes Estero. As a result, DBOC has been allowed to maintain manmade structures and operate motorboats and mechanized equipment in Drakes Estero. Under alternative A, the removal of human-made structures and motorboats from Drakes Estero would result in the complete removal of all nonconforming uses from the congressionally designated potential wilderness. This would allow NPS to convert the congressionally designated potential wilderness to congressionally designated wilderness and add it to the Phillip Burton Wilderness Area. This action would be consistent with the intent of the Point Reyes Wilderness Act of 1976. Under the procedures established for conversion, a notice would be published in the Federal Register confirming

the removal of all nonconforming uses and the area would then be included within the Phillip Burton Wilderness Area. Following conversion, NPS would manage Drakes Estero in accordance with the Wilderness Act and NPS wilderness management policies without exception.



The existing commercial shellfish materials in Drakes Estero, pictured here, would be removed (see photographic simulations in chapter 2). (Photo courtesy of VHB.)

As described above, alternative A would result in long-term beneficial impacts on wilderness because cessation of DBOC operations and removal of DBOC facilities would result in a readily apparent, widespread enhancement of wilderness characteristics and would allow for the conversion of the approximately 1,363 acres of congressionally designated potential wilderness to congressionally designated wilderness.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wilderness characteristics within the project area. These actions include monitoring/managing invasive species, planning and management activities, the Coastal Watershed Restoration: Geomorphic Restoration Project, and the CDFG MLPA initiative.

NPS would continue to monitor and manage invasive species, including *Didemnum*, Manila clams, and *Spartina* marshgrass. Invasive species alter the natural ecosystem; therefore, management that monitors and/or reduces invasive populations within Drakes Estero would improve the untrammeled and natural characteristics of wilderness areas.

Planning and management activities may authorize the use of motorboats within Drakes Estero for research or administrative purposes. Motorboat use within wilderness is subject to a minimum requirement analysis. The minimum requirement analysis would determine first whether the proposed action is appropriate or necessary for administration of the area as wilderness and whether it would cause a significant impact on

wilderness resources and character, in accordance with the Wilderness Act. Should administrative motorboat use be determined necessary, the minimum requirement concept would require further analysis of the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized (NPS 2006d). Because these permits would continue to be subject to the minimum requirements analysis, motorboat use related for research or administrative activities within Drakes Estero would not be expected to cause a noticeable long-term adverse impact on wilderness characteristics. Any noticeable adverse impacts on wilderness characteristics would be temporary.

The geomorphic restoration project (part of the coastal watershed restoration program) was completed in 2008. It removed a nonconforming structure (a road crossing Glenbrook Creek) from the Philip Burton Wilderness within the Drakes Estero watershed. In doing so, natural hydrology was restored to the site. The trail that used this road was rerouted upstream, where maintenance could be completed without use of mechanized equipment. This project resulted in a long-term beneficial impact on wilderness.

The designation of Drakes Estero as a marine protection area under the MLPA provides additional protection for natural resources in Drakes Estero (NPS adopts state fishing laws to the extent that they are not inconsistent with NPS management of the area). Under the MLPA, the only type of public fishing allowed in the marine protection area is the recreational take of clams. Because of Drakes Estero's potential wilderness status, members of the public who want to clam in Drakes Estero would have to do so without the use of mechanized equipment. Recreational take of clams would not interfere with preservation of wilderness characteristics in Drakes Estero.

These past, present, and reasonably foreseeable future actions would result in long-term beneficial impacts on wilderness characteristics. The impact of the past, present, and reasonably foreseeable future actions, in combination with the long-term beneficial effects of alternative A, would result in a long-term beneficial cumulative impact on wilderness due to the removal of the existing nonconforming uses associated with DBOC operations, which degrade wilderness characteristics and prevent conversion to congressionally designated wilderness status. Alternative A would contribute an appreciable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative A would result in long-term beneficial impacts on wilderness because cessation of DBOC operations and removal of DBOC facilities would result in a readily apparent, widespread enhancement of wilderness character. The enhancement of wilderness character would be due to removal of a commercial shellfish operation that detracts from wilderness character in the following ways:

- cultivation of nonnative shellfish (approximately 585,000 in 2010)
- maintenance of human-made mariculture infrastructure including 5 miles of racks and up to 88 acres of bottom bags in up to 142 acres of Drakes Estero
- motorboat travel taking place for up to 8 hours per day, 6 days per week, in approximately 740 acres of Drakes Estero
- generation of human-caused noise affecting wilderness

The cumulative impact would be long-term and beneficial, and alternative A would contribute an appreciable beneficial increment to the cumulative impact.

Alternative A would enable NPS to fulfill its obligations under the acts designating wilderness within the Seashore—PL 94-544 and PL 94-567—and NPS *Management Policies 2006* to actively seek to remove from potential wilderness the temporary, nonconforming conditions that preclude wilderness designation (NPS 2006d).

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wilderness include:

- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic
- Continued use of noise-generating equipment
- Production of up to 600,000 pounds of shellfish per year
- Species cultivated could include:
 - Permit Area 1: Pacific oysters, European flat oysters, and Manila clams
 - Permit Area 2: Purple-hinged rock scallops

The presence of DBOC's commercial shellfish operations, including cultivation of nonnative shellfish and maintenance of shellfish-related structures and materials and motorboats within Drakes Estero, would perpetuate the conditions that adversely impact wilderness characteristics and experiences within Drakes Estero. It also would result in 10 more years of nonconforming uses within congressionally designated potential wilderness, which would prevent conversion to congressionally designated wilderness. As described above, the four wilderness qualities are untrammeled, natural, undeveloped, and providing opportunities for solitude or a primitive and unconfined type of recreation.

An area is “untrammeled” when it is essentially free from modern human control or manipulation (Landres et al. 2008). Under alternative B, DBOC's bags, racks, and associated shellfish infrastructure would remain present in Drakes Estero, covering approximately 138 acres. DBOC also would continue to use motorboats to access these culture beds approximately eight hours a day, six days per week, for an additional 10 years. DBOC motorboat travel has been known to take place in up to 740 acres in Drakes Estero. These actions would perpetuate the presence of human-made structures and motorized boat traffic, both of which currently impose human manipulation on biophysical processes. Therefore, by permitting DBOC to operate for another 10 years, alternative B would result in an environment that is not untrammeled. This would have a readily apparent, widespread, adverse impact on wilderness character.

An area is “natural” when the ecological system is substantially free from the modern effects of modern civilization (Landres et al. 2008). Under alternative B, DBOC operations would impose a number of changes on the native species composition and habitat availability within the wilderness area. DBOC would continue to cultivate nonnative oysters and clams in Drakes Estero. Pacific oysters and Manila clams would be grown in Area 1 (formerly Lease M-438-01; 1,078 acres). Continued cultivation of

nonnative species alters the natural ecological system due to human manipulation. Under alternative B, NPS would limit production to 600,000 pounds of shellfish per year. The risk for active spread of naturalized species such as Manila clam and the invasive tunicate *Didemnum* would continue. Pacific oyster also have the potential to naturalize. In addition, the cultivation of these nonnative shellfish requires substrate on which oysters can grow. DBOC's use of racks, bags, and motorboats would have a number of impacts that would further alter the natural characteristics of Drakes Estero. Impacts from these items include shading of potential eelgrass habitat, approximately 8.5 linear miles of eelgrass damage from boat propellers, providing artificial habitat for structure-dependent fish species, adding manmade structures that may both increase habitat and decrease habitat for benthic organisms, and indirect introduction of nonnative species (i.e., the invasive tunicate *Didemnum*) and molluscan diseases. Additionally, the generation of noise by DBOC operations, both onshore and within Drakes Estero, would have the potential to disturb birds and harbor seals. Impacts on the ecosystem are described in additional detail under the "Wildlife and Wildlife Habitat" impact topics. Also, DBOC would continue to operate noise-generating equipment such as motorboats, pneumatic drills, the oyster tumbler, and onshore vehicles. Human-caused noise would continue to disturb wildlife within the project area. These activities would alter the natural ecosystem and natural soundscape in Drakes Estero. DBOC's operations under alternative B would result in a widespread and readily noticeable adverse impact on the natural aspects of wilderness character for an additional 10 year period.

An area is "undeveloped" when it retains "its primeval character and influence, and without permanent improvements or human habitation," with "the imprint of man's work substantially unnoticeable" (section 2[c] of the Wilderness Act). For many of the same reasons mentioned above, the presence of DBOC's commercial shellfish operations and manmade structures would negatively affect the primeval character and influence of Drakes Estero. Therefore, DBOC's operations under alternative B would result in a readily apparent, widespread adverse impact on the "undeveloped" characteristics of Drakes Estero for an additional 10 year period.

Lastly, wilderness areas provide "outstanding opportunities for solitude or primitive and unconfined recreation" (Landres et al. 2008). DBOC's continued operation of motorboats in Drakes Estero 6 days per week, approximately 8 hours per day for the next 10 years (DBOC [Lunny], pers. comm., 2011h) would disrupt the opportunities for visitors to experience solitude within Drakes Estero. Many visitors kayak or use other types of nonmotorized boats (such as canoes), a primitive and unconfined form of recreation, within Drakes Estero. Noise from both motorboats and onshore operations would detract from the opportunities for solitude for these visitors. DBOC's maintenance of nonnative shellfish and shellfish infrastructure within Drakes Estero also would visually intrude on this experience. Therefore, under alternative B, opportunities for solitude and primitive and unconfined recreation in Drakes Estero would be adversely affected by DBOC operations for an additional 10-year period resulting in readily apparent, widespread, adverse impacts on wilderness character.

Under alternative B, NPS would maintain the existing access road, kayak launch, parking lot, interpretive board, and vault toilet. These facilities are located outside wilderness. The impacts of this ongoing maintenance would be similar to those impacts described under alternative A; however, NPS would not install a gate to exclude visitors from Drakes Estero during harbor seal pupping season. The maintenance of these facilities would support continued access by park visitors to the wilderness areas of Drakes Estero, except during harbor seal pupping season. Motorboats may occasionally be used by NPS staff for

management or other purposes within Drakes Estero; however, such use would continue to be subject to a minimum requirement analysis, as described under alternative A.

NPS currently prohibits park visitors from using mechanized boats and equipment within the potential wilderness areas in Drakes Estero. This prohibition is consistent with the Wilderness Act and NPS *Management Policies 2006*, which require NPS to manage potential wilderness as wilderness to the extent that existing nonconforming uses allow (NPS 2006d). The DBOC commercial operation is the only nonconforming use in Drakes Estero, and its operations, most notably motorboat use six days per week and the maintenance of nonnative species and manmade infrastructure, are exempted from the prohibitions on commercial enterprise, mechanized equipment, and the installation of structures in potential wilderness. With the issuance of a new SUP for DBOC operations until 2022, DBOC operations would remain exempt from these prohibitions but the restrictions on park visitors would continue.

Issuance of a new SUP to DBOC would be inconsistent with the direction provided by Congress in the 1976 legislation establishing wilderness at Point Reyes and with NPS *Management Policies 2006*, which directs NPS to seek to remove nonconforming uses and convert congressionally designated potential wilderness to congressionally designated wilderness status (NPS 2006d). However, section 124 of PL 111-88 allows the Secretary to issue a permit to DBOC notwithstanding any other law, including the 1976 wilderness legislation.

As described above, alternative B would result in long-term major adverse impacts on wilderness because it would result in a readily apparent, widespread impact on wilderness characteristics and would prevent conversion of the 1,363 acres of congressionally designated potential wilderness within Drakes Estero to congressionally designated wilderness.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to wilderness characteristics in Drakes Estero. Commercial shellfish operations would cease within the project area and the resulting impacts on wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wilderness characteristics within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include monitoring/managing invasive species, planning and management activities, the Coastal Watershed Restoration: Geomorphic Restoration Project, and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term major adverse impacts of alternative B, would result in a long-term major adverse cumulative impact on wilderness characteristics. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative B would result in long-term major adverse impacts on wilderness for an additional 10 years because it would result in a readily apparent, widespread, adverse impact on wilderness character and would prevent conversion to congressionally designated wilderness from congressionally designated potential wilderness. The elements of DBOC's commercial shellfish operation that detract from wilderness character include:

- cultivation of nonnative shellfish (up to 600,000 pounds per year, although a small portion of this production may be purple-hinged rock scallop which may be native to Drakes Estero in larval form but is not likely to be found in Drakes Estero)
- maintenance of human-made mariculture infrastructure including 5 miles of racks and up to 84 acres of bottom bags in up to 138 acres of Drakes Estero
- motorboat travel taking place for up to 8 hours per day, 6 days per week, in approximately 740 acres of Drakes Estero and damaging approximately 8.5 linear miles of eelgrass
- generation of human-caused noise affecting wilderness (emanating from both inside and outside wilderness)

The cumulative impact would be long-term major adverse, and alternative B would contribute an appreciable adverse increment to the cumulative impact.

Alternative B would prevent NPS from fulfilling its obligations under the acts designating wilderness within the Seashore—PL 94-544 and PL 94-567—and NPS *Management Policies 2006* to actively seek to remove from potential wilderness the temporary, nonconforming conditions that preclude wilderness designation. However, section 124 of PL 111-88 allows the Secretary to issue a permit to DBOC notwithstanding any other law, including the 1976 wilderness legislation. During the term of the new permit, NPS would continue to manage Drakes Estero in accordance with the Wilderness Act and complementary NPS policy to the extent possible. However, motorboats and in-water infrastructure are necessary to support the shellfish operation. The use of motorboats six days per week, the presence of infrastructure related to the existing commercial shellfish operations, and the presence of a commercial enterprise within Drakes Estero would substantially detract from the wilderness characteristics of Drakes Estero for an additional 10 years.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wilderness are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC's racks and bags would occupy the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any

difference in impacts. The only action associated with alternative C that has the potential to have differing impacts from alternative B is:

- Species cultivated could include:
 - Permit Area 1: Pacific oysters, European flat oysters, and Manila clams
 - Permit Area 2: Manila clams and Purple-hinged rock scallops

The primary difference in impacts on wilderness between alternatives B and C would be related to which species would be cultivated in which area. Unlike alternative B, Manila clams would be limited to the 1-acre Area 2 under alternative C. Purple-hinged rock scallops would continue to be limited to Area 2, and Pacific oysters would continue to be cultivated in Area 1 (897 acres). The limitation of Manila clam production to Area 2 may reduce the risk of naturalization in Drakes Estero; however, such a risk would not be eliminated.

As described above, alternative C would result in long-term major adverse impacts on wilderness because it would result in a readily apparent, widespread, adverse impact on wilderness characteristics and would prevent conversion of the 1,363 acres of congressionally designated potential wilderness within Drakes Estero to congressionally designated wilderness.

As described under alternative B, upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to wilderness character in Drakes Estero. Commercial shellfish operations would cease within the project area and the resulting impacts would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wilderness characteristics within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include monitoring/managing invasive species, planning and management activities, the Coastal Watershed Restoration: Geomorphic Restoration Project, and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial impacts. The impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term major adverse impacts of alternative C, would result in a long-term major adverse cumulative impact on wilderness characteristics. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative C would result in long-term major adverse impacts on wilderness for an additional 10 years because it would result in a readily apparent, widespread, adverse impact on wilderness character and would prevent conversion to congressionally designated wilderness from congressionally designated potential wilderness. The elements of DBOC's commercial shellfish operation that detract from wilderness character include:

- cultivation of nonnative shellfish (up to 500,000 pounds per year, although a small portion of this production may be purple-hinged rock scallop which may be native to Drakes Estero in larval form but is not likely to be found in Drakes Estero)
- maintenance of human-made mariculture infrastructure including 7 miles of racks and up to 84 acres of bottom bags in up to 138 acres of Drakes Estero
- motorboat travel taking place for up to 8 hours per day, 6 days per week, in approximately 740 acres of Drakes Estero and damaging approximately 8.5 linear miles of eelgrass
- generation of human-caused noise affecting wilderness (emanating from both inside and outside wilderness)

The cumulative impact would be long-term major adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

Alternative C would prevent NPS from fulfilling its obligations under the acts designating wilderness within Point Reyes National Seashore—PL 94-544 and PL 94-567—and NPS *Management Policies 2006* to actively seek to remove from potential wilderness the temporary, nonconforming conditions that preclude wilderness designation (NPS 2006d). However, section 124 of PL 111-88 allows the Secretary to issue a permit to DBOC notwithstanding any other law, including the 1976 wilderness legislation. During the term of the new permit, NPS would continue to manage Drakes Estero in accordance with the Wilderness Act and complementary NPS policy to the extent possible. However, motorboats and in-water infrastructure are necessary to support the shellfish operation. The use of motorboats six days per week, the presence of infrastructure related to commercial shellfish operations, and the presence of a commercial enterprise within Drakes Estero would substantially detract from the wilderness characteristics of Drakes Estero for an additional 10 years.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for continued commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wilderness are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact wilderness include:

- Production of up to 850,000 pounds of shellfish per year
- Species cultivated could include: Pacific oysters, Olympia oysters, European flat oysters, Manila clams, and purple-hinged rock scallops

The limit on shellfish production under alternative D (850,000 pounds per year) would be higher than under alternatives B and C (600,000 and 500,000 pounds per year, respectively). DBOC has not submitted a detailed business plan for this level of operations. Nevertheless, it is reasonable to assume that this increase in production would result in increases in boat use, noise, processing hours onshore, vehicle use, and racks used and repaired, as well as the potential construction of a new processing facility. All of these changes would result in increased noise, disturbance, and visual impact in and adjacent to wilderness. The expansion

of human presence and activity within Drakes Estero, which would result in greater adverse impacts on wilderness character under alternative D, when compared to alternatives B and C.

The primary differences in impacts on wilderness between alternatives B and D would be related to which species would be cultivated in which area, shellfish production limits, and construction of new onshore facilities. Pacific oysters, Olympia oysters, Manila clams, and purple-hinged rock scallops would all be cultivated in Area 1 under this alternative. The increased potential for cultivation of species that are native to the California coast may represent a slightly more natural ecosystem despite the fact that these species (Olympia oyster and purple-hinged rock scallops) are not known to naturally occur in Drakes Estero in large numbers.

As described above, alternative D would result in long-term major adverse impacts on wilderness because it would result in a readily apparent, widespread impact on wilderness characteristics and would prevent conversion of the 1,363 acres of congressionally designated potential wilderness within Drakes Estero to congressionally designated wilderness.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to wilderness characteristics in Drakes Estero. Commercial shellfish operations would cease within the project area and the resulting impacts on wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact wilderness characteristics within the project area. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include monitoring and management of invasive species, planning and management activities, the Coastal Watershed Restoration: Geomorphic Restoration Project, and the CDFG MLPA initiative. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial impacts. The impact of the past, present, and reasonably foreseeable future actions, when combined with the long-term major adverse impacts of alternative D, would result in a long-term major adverse cumulative impact on wilderness characteristics. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative D would result in long-term major adverse impacts on wilderness for an additional 10 years because it would result in a readily apparent, widespread, adverse impact on wilderness character and would prevent conversion to congressionally designated wilderness from congressionally designated potential wilderness. The elements of DBOC's commercial shellfish operation that detract from wilderness character include:

- cultivation of nonnative shellfish (up to 850,000 pounds per year, although a portion of this production may be purple-hinged rock scallop which may be native to Drakes Estero in larval form but is not likely to be found in Drakes Estero)

- maintenance of human-made mariculture infrastructure including 7 miles of racks and up to 84 acres of bottom bags in up to 138 acres of Drakes Estero
- motorboat travel taking place for up to 8 hours per day, 6 days per week, in approximately 740 acres of Drakes Estero and damaging approximately 8.5 linear miles of eelgrass
- generation of human-caused noise affecting wilderness (emanating from both inside and outside wilderness)

The cumulative impact on wilderness would be long-term major adverse, and alternative D would contribute an appreciable adverse increment to the cumulative impacts.

Alternative D would prevent NPS from fulfilling its obligations under the acts designating wilderness within Point Reyes National Seashore—PL 94-544 and PL 94-567—and NPS *Management Policies 2006* to actively seek to remove from potential wilderness the temporary, nonconforming conditions that preclude wilderness designation (NPS 2006d). However, section 124 of PL 111-88 allows the Secretary to issue a permit to DBOC notwithstanding any other law, including the 1976 wilderness legislation. During the term of the new permit, NPS would continue to manage Drakes Estero in accordance with the Wilderness Act and complementary NPS policy to the extent possible. However, motorboats and in-water infrastructure are necessary to support the shellfish operation. The use of motorboats six days per week, the presence of infrastructure related to commercial shellfish operations, and the presence of a commercial enterprise within Drakes Estero would substantially detract from the wilderness characteristics of Drakes Estero for an additional 10 years.

IMPACTS ON VISITOR EXPERIENCE AND RECREATION

LAWS AND POLICIES

NPS *Management Policies 2006* (NPS 2006d) states that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks.

As summarized in chapter 3, section 5 of NPS *Management Policies 2006* (NPS 2006d) states that in its role as steward of park resources, the NPS must ensure that park uses that are allowed would not cause impairment of, or unacceptable impacts on, park resources and values. When proposed park uses and the protection of park resources and values come into conflict, the protection of resources and values must be predominant. Appropriate visitor enjoyment is often associated with the inspirational qualities of the parks. As a general matter, preferred forms of enjoyment are those that are uniquely suited to the superlative natural and cultural resources found in the parks and that (1) foster an understanding of and appreciation for park resources and values or (2) promote enjoyment through a direct association with, interaction with, or relation to park resources. These preferred forms of use contribute to the personal growth and well-being of visitors by taking advantage of the inherent educational value of parks. Equally important, many appropriate uses also contribute to the health and personal fitness of park visitors. These are the types of uses that the NPS will actively promote, in accordance with the NPS Organic Act.

Pursuant to *NPS Management Policies 2006* (NPS 2006d), concession contracts may only be awarded for certain, defined types of commercial operations which do not, and cannot, include commercial shellfish operations at DBOC. Concession contracts are limited, as a matter of law, to visitor services, that is, to public accommodations, facilities and services that are necessary and appropriate for public use and enjoyment of the unit of the National Park System in which they are located. Visitor services must also be consistent, to the highest practicable degree, with the preservation and conservation of the resources and values of the unit (16 U.S.C. sections 5951(b), 5952; 36 CFR section 51.3) (definition of “visitor service”).

Wilderness, as defined by the Wilderness Act of 1964, “has outstanding opportunities for solitude or a primitive and unconfined type of recreation.” The act further states that “wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use.”

METHODOLOGY

This section summarizes the impacts on visitor experience and recreation from the actions that would potentially occur under each alternative. The potential for change in visitor experience was evaluated by assessing the limitations and assumed changes to visitor access and associated visitor uses related to the proposed alternatives, and determining whether these projected changes would affect the visitor experience. In consideration of the existing conditions described in chapter 3, impacts are evaluated in the terms of the context, type (beneficial, adverse, direct, indirect), and duration (short-term and long-term).

Intensity Definitions

Minor:	The impacts would be slight but detectable and would not occur in primary resource areas or would affect few visitors. Impacts would not inhibit visitor enjoyment of resources for which the Seashore was established.
Moderate:	The impacts would be readily apparent in primary resource areas or would affect many visitors. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established.
Major:	The impacts would be severe in primary resource areas or would affect most visitors. The impacts would inhibit visitor enjoyment of resources for which the Seashore was established.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and

structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Termination of the existing commercial shellfish operation and removal of associated personal property from the site would provide visitors with a more natural experience within the project area. In particular, the removal of mariculture-related property, such as racks and bags, and associated debris would provide kayakers, hikers, and other visitors to the project area with a more natural view of Drakes Estero during low tide. Cessation of DBOC operations also would eliminate sound disturbances associated with commercial shellfish operations. Recreational use of motorboats in Drakes Estero would continue to be prohibited because of the congressional designation of potential wilderness. As such, visitors would be provided an opportunity for solitude and a primitive or unconfined type of recreation, a hallmark of a wilderness experience. From this perspective, alternative A would have a beneficial impact on visitor experience and recreation in the project area.

DBOC estimates that approximately 50,000 people visit the oyster company annually, comprising approximately 2.5 percent of the annual visitors to the Seashore (DBOC 2010n;^{xviii} NPS 2011a). Specific data regarding the percentage of DBOC visitors that travel to the Seashore solely to visit the oyster company are not available; however, it is likely that at least a portion of the annual visitors to the oyster company also visit other areas of the Seashore during their trip. The termination of commercial shellfish operations within Drakes Estero could adversely impact the experience for those visitors interested in mariculture and the recreational opportunities offered by the company (e.g., informative tours, oyster tasting). However, visitors to DBOC represent a small percentage of the total annual visitors to the Seashore and would still have the opportunity to visit the oyster companies along the east shore of Tomales Bay (Tomales Bay Oyster Company and Hog Island Oyster Farm). These operations are closer to Point Reyes Station and are operated adjacent to other NPS lands. In addition, the primary focus of DBOC is the commercial operation for sale of shellfish to restaurants and the wholesale shellfish market outside the park. These are not commercial services being offered to the visiting public to further the public's use and enjoyment of the park. As such, these are not visitor services.

Under alternative A, the existing access road, parking lot, interpretive board, and vault toilet would be maintained. The NPS also would install a gate to prevent vehicular access to the parking lot during harbor seal pupping season. The gate would prohibit motorized boat access to the water during this period, but would allow visitors to access Drakes Estero on foot. The proposed gate would allow visitors to access the site outside harbor seal pupping season (between July 1 and February 28). Installation of the gate would allow NPS to better enforce the existing seasonal closure of Drakes Estero during harbor seal pupping season (March 1 to June 30). Otherwise, maintenance of the existing NPS facilities would allow visitors to continue to benefit from these facilities. In particular, the parking facility allows for continued access to the beach and surrounding area, while the vault toilet ensures facilities for those visitors who wish to use the beach. The interpretive signs adjacent to the parking lot provide visitors with maps and important information about Drakes Estero and the harbor seal pupping season. The existing NPS facilities would be unchanged under alternative A; therefore, this element of alternative A would not impact visitor experience and recreation.

Based on the information provided above, alternative A would result in long-term beneficial impacts on visitor experience and recreation because termination of commercial shellfish operations within Drakes Estero would enhance the natural experience within the project area.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact visitor experience and recreation within the project area. These actions include kayaking, human-caused noise (other than DBOC), and planning and management activities.

Planning and management activities would continue to issue commercial use authorizations to commercial kayaking companies. Approximately 10 operators currently have commercial use authorizations from the Seashore to offer kayak equipment rentals and/or kayak tours within Drakes Estero. Of those authorized, only 3 provided kayak tours of Drakes Estero in 2010, accommodating a total of 221 visitors. If mariculture is terminated within Drakes Estero, authorized kayak tour operators may choose to expand their tours within Drakes Estero. Additional commercial operators also may apply for commercial use authorization within the Seashore. This would provide more visitors with the opportunity to experience kayaking in the Seashore and enjoy the surrounding landscape from within Drakes Estero. Ongoing commercial kayak tours as well as ongoing private kayaking within Drakes Estero would result in a long-term beneficial impact on visitor experience and recreation within the project area.

Human-caused noise from actions such as overflights and cars along Sir Francis Drake Boulevard would continue to detract from the wilderness experience being sought by visitors to Drakes Estero. Therefore, ongoing human-caused noise would result in a long-term minor adverse impact on visitor experience and recreation within the project area.

Based on the information above, despite some adverse cumulative impacts, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The beneficial impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial impacts of alternative A would result in beneficial cumulative impacts on visitor experience and recreation within the project area. Alternative A would contribute an appreciable beneficial increment to the cumulative impact on visitor experience and recreation.

Conclusion

Overall, alternative A would result in long-term beneficial impacts to visitor experience and recreation because it would increase the opportunity for solitude and primitive, unconfined recreation. Alternative A would maintain visitor access to Drakes Estero, limiting access to pedestrians during the annual seal pupping season (March 1 to June 30). As described above, those looking to experience an active commercial shellfish operation could be adversely impacted by alternative A. However, this population comprises 2.5 percent of the total annual visitors to the Seashore and other opportunities to experience an active commercial shellfish operation are provided in the immediate area. In addition, commercial shellfish operations are not considered a visitor service, a requirement for concession contracts within the Seashore. The cumulative impact would be beneficial, and alternative A would contribute an appreciable increment to the overall beneficial cumulative impacts.

With respect to visitor experience and recreation, alternative A is consistent with relevant law and policy because removal of DBOC would not represent the loss of a visitor service. Visitor services are defined

by law as public accommodations, facilities, and services that are necessary and appropriate for public use and enjoyment of the Seashore (36 CFR section 51.3).

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact visitor experience and recreation include:

- Continued tours of DBOC facilities (conducted by DBOC staff)
- Continued sale of DBOC shellfish products on site
- Continued use and maintenance of shellfish racks and bags in Drakes Estero
- Continued boat traffic

DBOC would continue to offer interpretive tours of its facilities (focused on the history of and process associated with shellfish operations within Drakes Estero) and continue to sell shellfish on site. Visitors to the project area would continue to have an opportunity to experience shellfish production first hand. Visitors could also purchase shellfish products on site and could consume them in the picnic area provided by DBOC.

Continued DBOC operations related to shellfish production may disrupt the recreational experience desired by some visitors to the Seashore, in particular those visitors seeking solitude and a primitive, unconfined type of recreation, a hallmark of a wilderness experience. As described in the “Impacts on Wilderness” section of this chapter, the presence of DBOC operations, including shellfish-related structures and materials and motorized boats within Drakes Estero, would perpetuate the conditions that adversely impact the wilderness qualities and experiences within Drakes Estero. The four wilderness qualities are untrammeled, natural, undeveloped, and providing opportunities for solitude or a primitive and unconfined type of recreation. Both the activities associated with mariculture in Drakes Estero and the presence of associated structures may be viewed preventing the experience of an untrammeled, natural environment. Onshore and offshore structures and associated debris related to shellfish operations could detract from the views of Drakes Estero, especially during low tide when offshore equipment such as racks and bags are visible (as shown in pictures in the “Impacts on Wilderness” section and chapter 2 of this document).

Alternative B would not noticeably change the visitor experience within the project area when compared to existing conditions; however, as specified in the methodology for this chapter, the impacts of the action alternatives are assessed against to the anticipated conditions under the no-action alternative.

As described above, alternative B would result in a long-term, moderate, adverse impact on visitor experience and recreation for another 10 years because impacts would be readily apparent in Drakes Estero (the primary resource area) and would affect many visitors to the Seashore. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in impacts to visitor experience and recreation in the project area. Commercial shellfish operations would cease within the project area and the resulting impacts would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact visitor experience and recreation within the project area. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include kayaking, human-caused noise, and planning and management activities, as described under alternative A.

For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impacts of past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative B, would result in long-term moderate adverse impacts on visitor experience and recreation. Alternative B would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative B would result in a long-term moderate adverse impact on visitor experience and recreation within the project area for an additional 10 years because continued commercial shellfish operations within Drakes Estero (the primary resource area) would be readily apparent and would affect many visitors to the Seashore. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established. Visual and sound disturbances associated with commercial shellfish operations would be readily apparent in the project area, and would be particularly adverse for visitors looking to enjoy solitude and primitive or unconfined type recreation within wilderness. Onshore and offshore structures and associated debris related to shellfish operations could detract from the views of Drakes Estero, especially during low tide when offshore equipment such as racks and bags are visible. Motorized boats also would continue to operate in Drakes Estero, which detracts from the natural soundscapes of the Seashore. The approximately 2.5 percent of visitors to the Seashore who are interested in experiencing an active commercial shellfish operation may consider alternative B to have a beneficial impact. However, the primary focus of DBOC is the commercial operation for sale of shellfish to restaurants and the wholesale shellfish market outside the park. These are not commercial services being offered to the visiting public to further the public's use and enjoyment of the park. Additionally, as described in alternative A, other opportunities to visit active shellfish operations are provided near the project area. The cumulative impact would be long-term moderate adverse, and alternative B would contribute an appreciable adverse increment to the cumulative impact.

With respect to visitor experience and recreation, this alternative does not further the goals of relevant law and policy. Visitor services must be consistent, to the highest practicable degree, with the preservation and conservation of the resources and values of the Seashore (16 U.S.C. sections 5951(b), 5952; 36 CFR

section 51.3) (definition of “visitor service”). DBOC’s operations are not consistent with the values for which Drakes Estero was congressionally designated as wilderness.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact visitor experience and recreation are the same as described under alternative B.

DBOC operations and facilities would be generally unchanged under alternative C, except that some existing unpermitted onshore structures, including the picnic area, would be removed from DBOC’s site. NPS would provide one in the vicinity. Therefore, alternative C would result in minimal changes to the overall visitor experience within the project area, as compared to current conditions. All other impacts would be the same as described under alternative B.

As described above, alternative C would result in a long-term, moderate, adverse impact on visitor experience and recreation within the Seashore for an additional 10 years because continued commercial shellfish operations within Drakes Estero (the primary resource area) would be readily apparent and would affect many visitors to the Seashore. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in impacts to visitor experience and recreation in the project area. The impacts associated with this conversion to congressionally designated wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact visitor experience and recreation within the project area. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include kayaking, human-caused noise, and planning and management activities.

For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of past, present, and reasonably foreseeable future actions would be long-term beneficial. The impacts of past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative C, would result in a long-term moderate adverse cumulative impact on visitor experience and recreation. Alternative C would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

Overall, alternative C would result in a long-term, moderate, adverse impact on visitor experience and recreation in the project area for an additional 10 years because continued commercial shellfish operations within Drakes Estero (the primary resource area) would be readily apparent and would affect many visitors to the Seashore. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established. DBOC operations would be generally unchanged under alternative C, for an additional 10 years, despite some modifications proposed to the existing facilities and production levels. The visitor experience and recreational opportunities at the site would be similar to current conditions, except that the existing, unpermitted picnic area would be removed and would be replaced by NPS. Visual and sound disturbances associated with commercial shellfish operations would be readily apparent in the project area, and the impact would be particularly adverse for visitors looking to enjoy solitude and primitive, unconfined type recreation within the Seashore. Onshore and offshore structures and associated debris related to shellfish operations could detract from the views of Drakes Estero, especially during low tide when offshore equipment such as racks and bags are visible. Motorized boats also would continue to operate in Drakes Estero, which detracts from the natural soundscapes of the Seashore. The approximately 2.5 percent of visitors to the Seashore who are interested in experiencing an active commercial shellfish operation may consider alternative C to have a beneficial impact. The primary focus of DBOC is the commercial operation for sale of shellfish to restaurants and the wholesale shellfish market outside the park. These are not commercial services being offered to the visiting public to further the public's use and enjoyment of the Seashore. Additionally, as described in alternative A, other opportunities to visit active shellfish operations are provided near the project area. The cumulative impact would be long-term moderate adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

With respect to visitor experience and recreation, alternative C does not further the goals of relevant law and policy. Visitor services must be consistent, to the highest practicable degree, with the preservation and conservation of the resources and values of the Seashore (16 U.S.C. sections 5951(b), 5952; 36 CFR section 51.3) (definition of “visitor service”). DBOC’s operations are not consistent with the values for which Drakes Estero was congressionally designated as wilderness.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for continued commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact visitor experience and recreation are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact visitor experience and recreation include:

- Increased production limit
- New onshore development

Alternative D would provide for the production and distribution of a larger variety of shellfish (Pacific oysters,

Olympia oysters, Manila clams, and purple-hinged rock scallops) and would increase production limits to 850,000 pounds of shellfish (approximately 40 percent greater than alternative B and 70 percent greater than alternative C). For visitors seeking a natural experience and/or solitude, the increased production levels may have a greater impact on visitor experience and recreation than alternatives B and C because increased production levels would likely result in greater motorized boat activity within Drakes Estero.

Alternative D would include a new processing plant and interpretive facility. The interpretive facility proposed by DBOC would likely focus on educating visitors about the history of and process associated with shellfish operations within Drakes Estero and is not consistent with the NPS requirements for interpretive services, as described in the *NPS Management Policies 2006* (NPS 2006d). DBOC has submitted two concepts for what expanded development at the site might look like under alternative D. Modifications that could occur under Option 1 include a new two-story processing and interpretive facility, and an aquarium. Based on the most recent proposal from DBOC, Option 2 of alternative D includes the removal of nearly all existing DBOC facilities (DBOC 2011g^{xix}). To replace those buildings demolished under Option 2, this version of alternative D would include the construction of a new multipurpose building, which would serve both processing and interpretive activities for DBOC (DBOC 2011g^{xx}). The larger interpretive facilities proposed under both options of alternative D could allow DBOC to accommodate larger tour groups. Visitors also would be provided with increased opportunities to experience the stages of shellfish processing in an improved interpretive facility and retail shop. The new facilities would provide visitors with the opportunity to view the entire shellfish production process (seed production to shucking and packing) (DBOC 2011g^{xxi}).

Continued, expanded shellfish production at DBOC may disrupt the recreational experience desired by some visitors to the Seashore, in particular those visitors seeking solitude and a primitive, unconfined type of recreation. As described in the “Impacts on Wilderness” section of this chapter, the presence of an active commercial shellfish operation within Drakes Estero, including related structures and materials and motorized boats, would perpetuate the conditions that adversely impact the wilderness qualities and experiences within Drakes Estero. The adverse impacts associated with this alternative would be slightly greater than those associated with the other action alternatives because of the increased production levels proposed. In particular, motorized boat traffic would likely increase. During DBOC’s redevelopment of the site, demolition of existing facilities and construction of new facilities would involve the use of heavy equipment, which would further detract from the peaceful, natural experience that Seashore visitors may be seeking for the duration of the redevelopment.

As described above, alternative D would result in a long-term moderate adverse impact on visitor experience and recreation within the project area for an additional 10 years because continued commercial shellfish operations within Drakes Estero would be readily apparent in Drakes Estero (the primary resource area) and would affect many visitors to the Seashore. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established. Alternative D would also result in short-term moderate adverse impacts on visitor experience and recreation during construction activities for the same reasons.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in impacts to visitor experience and recreation in the project area. The impacts associated with this conversion to congressionally designated wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact visitor experience and recreation within the project. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include kayaking, human-caused noise, and planning and management activities. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of past, present, and reasonably foreseeable future actions would be long-term beneficial. The impacts of past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts of alternative D, would result in a long-term moderate adverse cumulative impact on visitor experience and recreation. Alternative D would contribute an appreciable adverse increment to the cumulative impact.

Conclusion

As described above, alternative D would result in a long-term moderate adverse impact on visitor experience and recreation within the project area for an additional 10 years because continued commercial shellfish operations within Drakes Estero (the primary resource area) would be readily apparent and would affect many visitors to the Seashore. The impacts would somewhat inhibit visitor enjoyment of resources for which the Seashore was established. Under alternative D, the visitor experience and recreational opportunities provided by DBOC would be generally similar to current conditions, despite proposed modifications to existing facilities and operations. Similar to alternatives B and C, visual and sound disturbances associated with commercial shellfish operations would be readily apparent in the project area, and this impact would be particularly adverse for visitors seeking solitude and a primitive, unconfined type of recreation. These adverse impacts would be greater than under alternatives B and C due to the increased production limits (approximately 40 percent greater than alternative B and 70 percent greater than alternative C), which would likely increase motorized boat activity and the quantity of bags and associated mariculture items within Drakes Estero. Additionally, in the short-term, construction activities associated with alternative D could result in additional adverse impacts on visitor experience and recreation in Drakes Estero. In particular, such activities could further disturb soundscapes and views within Drakes Estero. The approximately 2.5 percent of visitors to the Seashore who are interested in experiencing an active commercial shellfish operation may consider alternative D to have a greater beneficial impact than the other alternatives. However, the primary focus of DBOC is the commercial operation for sale of shellfish to restaurants and the wholesale shellfish market outside the park. These are not commercial services being offered to the visiting public to further the public's use and enjoyment of the park. Additionally, as described in alternative A, other opportunities to visit active shellfish operations are provided near the project area. The cumulative impact on visitor experience and recreation would be long-term moderate adverse, and alternative D would contribute an appreciable adverse increment to the cumulative impact.

With respect to visitor experience and recreation, alternative D does not further the goals of relevant law and policy. Visitor services must be consistent, to the highest practicable degree, with the preservation and conservation of the resources and values of the Seashore (16 U.S.C. sections 5951(b), 5952; 36 CFR section 51.3) (definition of "visitor service"). DBOC's operations are not consistent with the values for which Drakes Estero was congressionally designated as wilderness.

IMPACTS ON SOCIOECONOMIC RESOURCES

LAWS AND POLICIES

The CEQ regulations implementing NEPA require that economic and social impacts be analyzed when they are interrelated with natural or physical impacts. Additionally, *NPS Management Policies 2006* requires the NPS to identify any impact on socioeconomic resources when determining the feasibility of a proposed action (NPS 2006d).

METHODOLOGY

This section summarizes how the impacts on socioeconomic resources from the actions that would potentially occur under each alternative are evaluated. Western Marin County is primarily rural, with scattered, small, unincorporated towns that serve tourism, agriculture, and local residents. Potential impacts on socioeconomic resources were developed based on several sources of information, including official visitation statistics, information from previous studies, data provided by DBOC, the Seashore, and CDFG, and public scoping comments. Impacts are evaluated with regard to the type of impact (direct and indirect) and the context of the impact. At a regional (Marin County) or statewide level (depending on the scale of comparative data), this section considers whether impacts would be noticeable to the greater population and whether they would exceed regional thresholds (such as unemployment levels). In addition to the regional scale, the socioeconomic analysis evaluates impacts on the Inverness Census Designated Place (Inverness), which is within Marin County. As the nearest municipality to the project area, socioeconomic data from Inverness best reflects the conditions within the project area and offers an appropriate comparison to overall Marin County data. This section also evaluates whether potential impacts would be perceptible to DBOC staff and their families. The analysis assumes that upon expiration of the SUP, whether it is 2012 or 2022, DBOC operations would terminate.

This section compares shellfish production at DBOC to overall statewide shellfish production, based on 2007/2008 data compiled from CDFG, the Pacific Coast Shellfish Growers Association, and an independent survey of the California shellfish industry prepared by Ted Kuiper. As described in Chapter 3, the CDFG has acknowledged that their statewide production summaries do not accurately represent the total annual shellfish production in California. One reason is because the available CDFG data are not inclusive of all statewide oyster production. Some operations on private or granted tidelands are not accounted for in the totals because they are not required to report production data to CDFG. CDFG manages 18 leases for 9 mariculture operations, including the 2 leases at DBOC. With the exception of DBOC, these operations are located on state-owned tidelands. In addition, approximately 19 aquaculture operations in the state that operate on granted or private tide and submerged lands not owned by the State of California (CDFG [Ramey], pers. comm., 2011d).

Another reason the statewide production summaries do not accurately represent the total annual shellfish production in California is because shellfish weight is not estimated consistently for all shellfish operations. For aquaculture operations under state lease, shellfish production is reported to CDFG as the total number of shellfish produced, and is then converted into total weight (in pounds). Oyster weight is estimated based on gallons of oysters, which are estimated based on the total number of oysters produced.

The number of Pacific oysters per gallon varies among shellfish operations. Typically, either 100 or 140 Pacific oysters are used to comprise a gallon. At DBOC, CDFG has consistently considered 100 oysters to be a gallon (to report production numbers as well as calculate privilege use taxes), while in Tomales Bay, the weight has been calculated using the 140 oyster per gallon factor. In addition, the conversion factor also varies by type of oyster. Approximately 300 Kumamoto or Eastern oysters comprise a gallon, compared to 140 European flat oysters per gallon, and 400 Olympia oysters per gallon. These conversion factors have not been applied consistently to statewide production estimates; therefore, it is difficult to provide an exact percentage of DBOC's share of the California oyster and/or shellfish market. CDFG appears to have assumed 100 or 140 oysters per gallon for all types of oysters. Shellfish production data reported by Ted Kuiper, which was used by the Pacific Coast Shellfish Growers Association to determine 2008 oyster production rates and values in California, assumes an average of 180 oysters per gallon to estimate both value and total oysters produced (Kuiper 2009).

Calculations of Pacific oyster, total oyster, and shellfish produced in California for this analysis assume the following:

- One gallon of oyster meat weighs 8.5 pounds
- Twenty mussels weigh 1 pound
- Thirty clams weigh 1 pound

This analysis also considers that CDFG estimates of oyster production in Humboldt Bay appear to be low. According to the Made in Humboldt Bay website, 70 percent of the fresh oysters consumed in California are produced in Humboldt Bay (Humboldtmade.com 2011). Approximately 60,000-80,000 gallon of oysters are produced in Humboldt Bay annually to be shucked, canned, and/or sold in the half shell. An additional 450,000 individual oysters also are produced in Humboldt Bay each year for distribution in the shell (Molina 2011). Coast Seafoods, the largest shellfish operation in Humboldt Bay produces an estimated 60,000 gallons (each gallon contains 100-200 oysters) of oysters annually (Poor 2011). Coast Seafoods produces both Pacific and Kumamoto oysters.

Due to the varying approaches used to estimate statewide oyster production rates and value in California, DBOC's share of the oyster and shellfish market is presented as a range in this chapter. As described in Chapter 3, in 2007/2008, shellfish harvested from DBOC comprised between 16 and 34 percent of the oysters and between 13 and 28 of the shellfish produced in California. These ranges are applied, as appropriate, throughout this chapter. However, because Manila clams were not harvested at DBOC until 2009 and CDFG is the only available statewide data for that year, DBOC's share of the statewide Manila clam market was estimated in comparison to CDFG data only.

Geographic Area Evaluated for Impacts (Area of Analysis)

- Regional study area:** For the purposes of this socioeconomic impacts analysis, the regional area of analysis is defined as Marin County. Regional impacts include those that would be noticeable to the greater Marin County population and/or small businesses.
- Statewide study area:** For the purposes of evaluating DBOC shellfish production in this socioeconomic impact analysis, the State of California is considered the area of analysis for

consistency with available shellfish production data, which is described in Chapter 3 and summarized in the methodology above.

Intensity Definitions

Minor:	Impacts may be detectable but would not affect the overall regional economy or the statewide production of shellfish.
Moderate:	Impacts would be clearly detectable but would not considerably affect the regional economy or the statewide production of shellfish.
Major:	Impacts would be highly noticeable and would substantially influence the regional economy or the statewide production of shellfish.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including commercial shellfish infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The termination of commercial shellfish operations within Drakes Estero would result in the loss of 31 full-time jobs and 1 part-time job, which includes all current DBOC staff (DBOC 2010;^{xxii}). From a regional perspective, 26 full-time DBOC staff and 1 part-time DBOC staff live within Marin County (22 of these within Inverness) and 5 full-time DBOC staff live within Sonoma County. DBOC makes up approximately 0.02 percent of the labor force within Marin County, 3 percent of the labor force in Inverness, and 0.002 percent of the labor force within Sonoma County (DBOC 2010;^{xxiii} U.S. Census Bureau 2005–2009). Assuming consistency with current employment data for Marin County and Inverness, the closure of DBOC would not increase unemployment in these locales to a level above the 2009 statewide average which is 11.3 percent (U.S. Department of Labor 2011; U.S. Census Bureau 2005–2009). Unemployment rates in Marin County were well below statewide averages in 2009 (7.9 percent). Inverness CDP reported zero unemployment (U.S. Census Bureau 2005–2009). Although the percent increase in the unemployment within Inverness would be greater than that experienced by Marin County as a whole, unemployment levels would be approximately 3 percent, and well below statewide averages (U.S. Census Bureau 2005–2009).

In addition to the loss of jobs, alternative A would require the relocation of 15 DBOC staff and their family members who currently live in the five housing units (three mobile homes and two permanent wood-frame houses) at the site (DBOC 2010;^{xxiv}, 2010k^{xxv}). At the time of report preparation, information pertaining to the total number of residents living in DBOC-provided housing was not readily available. Because these housing units are owned by either the NPS (main house and cabin) or DBOC (three mobile homes), and not the individuals who live there, the current residents would not be compensated for vacating these units. Housing costs within Marin County and Inverness are extremely high. The average cost to purchase or rent a home within Marin County and Inverness were over \$800,000 or approximately

\$1,500 per month, respectively, in 2009 (U.S. Census Bureau 2005–2009). As such, individuals may not be able to relocate in the immediate area. Former staff who choose to relocate outside of Marin County would have an impact on the regional economy, because they would no longer be spending money at local establishments. Due to the small number of DBOC staff and their families affected by the relocation, this impact would be minimal. From a regional standpoint, the five housing units at DBOC comprise less than 0.01 percent of the housing in Marin County and 0.4 percent of the homes in Inverness (U.S. Census Bureau 2005–2009). Additionally, DBOC staff make up only a small percentage of the population of both Marin County (0.01 percent) and Inverness (2.9 percent) (U.S. Census Bureau 2005–2009).

If existing authorizations for DBOC are allowed to expire, DBOC would no longer produce and sell/distribute shellfish within Drakes Estero, and DBOC would cease to operate. DBOC estimates that approximately 50,000 people visit the oyster company annually (DBOC 2010^{xxvi}). This amounts to approximately 2.5 percent of the total visitors to the Seashore (NPS 2011a). As described in chapter 3, these visitors are likely to contribute to the regional economy by spending money at local establishments such as restaurants, shops, and/or hotels/motels. It is assumed that the Seashore, as a whole, would continue to contribute to the regional economy, at current levels, through local spending (approximately \$86 million in 2009) (NPS 2011d). NPS payroll at the Seashore in 2009 supported a total of 160 private sector and NPS staff, including 129 NPS jobs, resulting in approximately \$10 million in labor income and approximately \$13 million in value added for the region (NPS 2011d). Specific data regarding the percentage of DBOC visitors who travel to the Seashore solely to visit the oyster company are not available; however, the effect of commercial shellfish production by DBOC in the Seashore on the aggregate economic values generated by the Seashore is likely to be relatively small when compared to the recreational value, which is approximately \$100 million per year (NAS 2009). The termination of commercial mariculture operations within the Seashore is not anticipated to reduce visitation enough to have a noticeable impact on the regional economy because of its relatively small contribution. Based on recent economic contributions, DBOC is estimated to generate an annual payroll of approximately \$1 million and to account for 2 to 3 percent of agricultural employment in the greater San Francisco-San Mateo-Redwood City metropolitan area (NAS 2009). Therefore, even if all of the estimated 50,000 annual visitors to DBOC chose not to visit the Seashore, the 2.5 percent decline would be detectable but would not affect the overall regional economy.

Under alternative A, the existing access road, parking lot, interpretive board, and vault toilet would be maintained. The NPS also would install a gate to limit recreational access to Drakes Estero during harbor seal pupping season. The maintenance of existing NPS facilities within the project area would facilitate ongoing use of Drakes Estero for kayaking. As described in the “Impacts on Visitor Experience and Recreation” section of this chapter, the termination of commercial mariculture within the project area may attract additional visitors, especially those who are interested in kayaking in a natural environment and/or enjoying solitude. Such visitors may have avoided kayaking within Drakes Estero previously due to existing commercial operations. If additional kayakers are attracted to the Seashore, they could contribute to the regional and state economies by spending money at local establishments and help offset any visitor loss associated with those only interested in visiting DBOC.

Terminating commercial shellfish operations at DBOC would eliminate a local source of shellfish for the San Francisco Bay Area. Approximately 80 to 90 percent of the shellfish produced at DBOC is distributed to the region (DBOC [Lunny], pers. comm., 2011h). Pacific oysters harvested at DBOC constitute between 16 and 34 percent of the California oyster market and between 13 and 28 percent of

the overall shellfish market, depending on the metric considered (value, weight, or total number of individual oysters) and the source of the statewide estimates (see Chapter 3) (CDFG 2011a, 2011c, 2011e; PCSGA 2009; Kuiper 2009).

Between 2007 and 2009, an average of 1.17 million pounds of shucked Pacific oyster meat, 1.24 million pounds of total shucked oyster meat, and 1.65 million pounds of shellfish were produced annually in California (CDFG 2011a, 2011c). Manila clams harvested at DBOC in 2009 and 2010 encompassed only 1 percent and 0.04 percent, respectively, of the total Manila clams harvested in California those years. Manila clams were the only clams harvested in California in 2009 and 2010 (CDFG 2011b).

As described above, alternative A would result in long-term, minor, adverse impacts on regional socioeconomic resources because DBOC staff would lose jobs and some staff and their families would also lose housing. From a regional perspective, these impacts would be detectable but would not affect the overall regional economy. Alternative A could result in long-term major adverse impacts to California's shellfish market because the loss of DBOC production (estimated at 13 to 28 percent of the state's shellfish production) would cause a highly noticeable change in statewide shellfish production.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact regional socioeconomic resources. These actions include existing ranching operations, kayaking within Drakes Estero, the proposed California Aquaculture Programmatic Environmental Impact Report (PEIR), changes to NOAA aquaculture policies, and economic trends.

Similar to DBOC, the existing ranches contribute to the regional economy by providing jobs for many area residents and offering a local specialty food source. Continued operation of the ranches would maintain a long-term beneficial impact on the regional economy.

A small number of the authorized kayak tour operators in the area currently offer tours within Drakes Estero. However, if commercial mariculture within Drakes Estero is terminated and the project area is converted to congressionally designated wilderness area, the demand for kayak tours within Drakes Estero may increase. This could cause more of the authorized operators to offer tours, or additional kayak operators may apply for permits to provide tours within Drakes Estero, which may help to offset the loss of visitors to DBOC. Increased interest in kayaking within Drakes Estero would support the kayak operators, which, in most cases, are local small businesses. The potential increase in commercial kayak tours within Drakes Estero is not likely to noticeably impact the regional economy.

The California Aquaculture PEIR, which is currently being developed, would alter CDFG's management of its leasing program for aquaculture along the coast of California. The PEIR, which is primarily focused on regulatory issues associated with California aquaculture, could result in changes to the total production acreage within the state. Such regulatory changes could alter shellfish production levels. The inclusion of more or less stringent regulations also could lead to increased or reduced shellfish production, respectively. Changes in shellfish production levels could affect local jobs (either create more, or reduce some), profits for local businesses that produce shellfish, and any taxes associated with shellfish production and distribution. At this time, the PEIR is in the initial drafting stages and sufficient

information is not available to determine if production would increase or decrease as a result of PEIR implementation. As such, the potential impact of the PEIR on socioeconomic conditions within Marin County cannot be assessed at this time and is not considered in the overall determination of cumulative impacts on regional socioeconomic resources. The outcome of this planning effort could have beneficial or adverse effects on the statewide shellfish industry.

In an effort to reduce seafood imports and support the U.S. economy, national sustainable marine aquaculture policies have been established by the U.S. Department of Commerce and NOAA (NOAA 2011a). These policies have been specifically designed to support a national approach to sustainable aquaculture that will meet the increased demand for healthy seafood in the U.S; support coastal communities, including commercial and recreational fisheries; and restore vital species and habitat. Primary efforts include “encouraging and fostering sustainable aquaculture that increases the value of domestic aquaculture production and creates American business, jobs, and trade opportunities... [and] promoting a level playing field for U.S. aquaculture businesses engaged in international trade, working to remove foreign trade barriers, and enforcing our rights under U.S. trade agreements” (NOAA 2011a). The implementation of the aquaculture policy could have a long-term beneficial impact on socioeconomic resources in Marin County, especially in those areas where aquaculture is prevalent.

The current economic recession is having a dampening effect on the national and local economy; however, despite the poor economic conditions, visitation to the Seashore has remained generally steady, declining only 8 percent since 2008. Unemployment rates in both the state and Marin County have increased since 2008 (U.S. Department of Labor 2011). Over time, increasing population and economic opportunities should provide beneficial impacts to the economy of Marin County. Based on the information above, the impact of these past, present, and reasonably foreseeable future actions on the regional economy would be long-term beneficial. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term minor adverse impacts of alternative A would result in a long-term minor adverse cumulative impact on regional socioeconomic resources. Alternative A would contribute a noticeable adverse increment to the cumulative impact.

Past, present, and reasonably foreseeable future actions also have the potential to impact shellfish production within California. These actions include the proposed California Aquaculture PEIR, the expansion of mariculture within Humboldt Bay, and changes to NOAA aquaculture policies.

As described above, the PEIR is in the initial drafting stages and sufficient information is not available to determine if production would increase or decrease as a result of PEIR implementation. As such, the potential impact of the PEIR on California aquaculture cannot be assessed at this time and is not considered in the overall determination of cumulative impacts on California shellfish production.

If mariculture within Humboldt Bay is expanded, it would allow that region to produce a larger percentage of California’s shellfish. Humboldt Bay currently produces 70 percent of the fresh oysters consumed in California (humboldtmade.com 2011). In 2011, the Headwaters Fund awarded a grant to the Humboldt Bay Harbor District to support planning and permitting that would double areas available to shellfish production in Humboldt Bay. If shellfish operations within Drakes Estero cease in 2012, the proposed increase in mariculture in Humboldt Bay could help reduce the associated socioeconomic impacts to the statewide oyster and clam production. As such, the expansion of mariculture within Humboldt Bay could result in long-term beneficial impacts on statewide shellfish production.

As described relative to regional socioeconomic resources, the primary focus of the new NOAA aquaculture policies include “encouraging and fostering sustainable aquaculture that increases the value of domestic aquaculture production and creates American business, jobs, and trade opportunities... [and] promoting a level playing field for U.S. aquaculture businesses engaged in international trade, working to remove foreign trade barriers, and enforcing our rights under U.S. trade agreements (NOAA 2011a).” As such, it is anticipated that the implementation of the aquaculture policy would have a long-term beneficial impact on shellfish production in California.

Based on the information above, the impact of these past, present, and reasonably foreseeable future actions on the California shellfish market would be long-term beneficial. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term major adverse impacts of alternative A would result in a long-term minor adverse cumulative impact on statewide shellfish production. Alternative A would contribute a noticeable adverse increment to the cumulative impact.

Conclusion

Overall, alternative A would result in long-term minor adverse impacts on regional socioeconomic resources. DBOC staff and their families would experience a direct, adverse impact under alternative A due to the loss of jobs and housing. However, from a regional perspective, these impacts would be minimal, and would not affect the overall regional economy. DBOC staff comprises 0.01 percent of the Marin County population and 2.9 percent of the Inverness population (U.S. Census Bureau 2005–2009). Jobs lost in connection with the closure of DBOC make up only a small percentage of the total labor force for Marin and Sonoma counties and Inverness, and even with the added job loss, assuming these jobs are not replaced by expanded mariculture operations elsewhere, unemployment rates within Marin County and Inverness CDP would be well below statewide averages, at 7.9 percent and zero percent respectively (U.S. Census Bureau 2005–2009). In addition, the relocated households encompass a small percentage of the total households in the surrounding communities (less than 0.01 percent of the housing in Marin County and 0.4 percent of the homes in Inverness) (U.S. Census Bureau 2005–2009). Therefore, even if all former staff relocates to another community and/or county, the impact on the regional economy would be minimal. Additionally, it is assumed that the Seashore, as a whole, would continue to contribute to the regional economy, at current levels, through local spending (approximately \$86 million in 2009) and by supporting jobs (resulted in \$13 million in added value to the region in 2009) (NPS 2011d). The cumulative impact on the regional economy would be long-term minor adverse, and alternative A would contribute a noticeable adverse increment to the cumulative impact.

Alternative A could result in long-term major adverse impacts to California’s shellfish market because DBOC produces 16–34 percent of the oysters harvested in California and 13–28 percent of the total shellfish grown in the state. The cessation of commercial shellfish operations within Drakes Estero would be highly noticeable and could substantially influence the production of shellfish in California. The cumulative impact on the California shellfish market would be long-term minor adverse, and alternative A would contribute a noticeable adverse increment to the cumulative impact.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for continued commercial shellfish operations within Drakes Estero. Actions associated with this alternative that have the potential to impact socioeconomic resources include:

- Provision of employment
- Provision of housing
- Species cultivated could include:
 - Permit Area 1: Pacific oysters, European flat oysters, and Manila clams
 - Permit Area 2: Purple-hinged rock scallops
- Production of up to 600,000 pounds of shellfish per year

DBOC's operations would be largely unchanged from existing conditions under this alternative. No jobs would be lost as a result of alternative B. Alternative B would provide for the ongoing sale of shellfish and "complementary food items" by DBOC. DBOC would maintain production and distribution of Pacific oyster products and European flat oysters with their existing trucks, or comparable replacements, within an approximately 100-mile radius of DBOC. As under current conditions, Manila clams would be sold on site and to select local restaurants due to their limited production (DBOC [Lunny], pers. comm., 2011h). As described under alternative A, approximately 80 to 90 percent of the shellfish produced at DBOC is distributed to the region, comprising, between 16 and 34 percent of the California oyster market and between 13 and 28 percent of the overall shellfish market in the state (DBOC [Lunny], pers. comm., 2011h; CDFG 2011a, 2011c, 2011e; PCSGA 2009; Kuiper 2009). DBOC also produces approximately 1 percent of the total Manila clams harvested in California (CDFG 2011a, 2011c).

As described under alternative A, DBOC estimates that approximately 50,000 people visit the oyster company annually (DBOC 2010n^{xxvii}). DBOC visitors also are likely to spend money at local restaurants, shops, and/or hotels/motels, contributing further to the regional economy. It is assumed that the Seashore, as a whole, would continue to contribute to the regional economy, at current levels, through local spending by supporting jobs.

Under alternative B, DBOC would no longer operate under a state water bottom lease from CDFG. As a result, DBOC would not pay some of the fees or taxes that CDFG assesses on shellfish operators. The CDFG administers state water bottom leases and collects revenues from their leaseholder. Lessees pay an annual per acre rental fee and a privilege use tax (\$0.04 per gallon for oyster, \$0.0125 per pound for other shellfish) to the CDFG. Instead, under this alternative, pursuant to section 124 of PL 111-88, DBOC would pay the United States an annual fee based on the fair market value of its use of the onshore and offshore federal property permitted to DBOC. The NPS, through the Department of the Interior Office of Valuation Services, has initiated an appraisal process to determine the fair market value of the project area. The appraisal will be conducted in accordance with federal appraisal standards and will be used to establish the fair market value of the new permit. The fair market value fee could result in annual payments being greater to or less than what DBOC currently pays to CDFG. In addition, DBOC would

continue to pay other state and local taxes associated with its business. However, information related to such taxes was not readily available during EIS preparation.

The existing facilities at DBOC would be generally unchanged under alternative B, including the five housing units (three mobile homes and two permanent wood-frame houses). Staff would not have to relocate. As a result, this alternative would have no impact on housing. Additionally, the staff who live in DBOC housing would maintain their contributions to the regional economy by spending money at local establishments such as restaurants/bars and retailers.

As described above, alternative B would result in long-term beneficial impacts on regional socioeconomic resources due to the continued operation of a commercial shellfish facility within Drakes Estero for another 10 years. No jobs or housing would be lost and both the Seashore and DBOC would continue to contribute to the regional economy at current levels. This alternative would result in a long-term beneficial impact to shellfish production in California because DBOC would continue to contribute to the statewide shellfish market for another 10 years.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to socioeconomic resources. The commercial shellfish operation within Drakes Estero would no longer contribute to the state's shellfish market and housing and employment would no longer be provided at the site for the current DBOC staff. Impacts to socioeconomic resources associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact socioeconomic resources within the project area and the region. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include ranching operations, kayaking within Drakes Estero, the proposed California Aquaculture PEIR, the expansion of mariculture within Humboldt Bay, changes to NOAA aquaculture policies, and economic trends. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial impacts of alternative B would result in a long-term beneficial cumulative impact on regional socioeconomic resources as well as statewide shellfish production. Alternative B would contribute a noticeable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative B would result in long-term beneficial impacts on socioeconomic resources due to the continued operation of a commercial shellfish facility within Drakes Estero for another 10 years. DBOC would continue to provide employment and housing to DBOC staff and their families. DBOC's contribution to the regional tax base would not change substantially from current levels (taxes are based

on production levels), and DBOC would continue to provide a local food source for the region, for an additional 10 years, in quantities similar to current distribution. Additionally, it is assumed that visitor spending at the Seashore would continue at current levels. The cumulative impact on both the regional economy and statewide shellfish production would be long-term beneficial, and alternative B would contribute a noticeable beneficial increment to the cumulative impact.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Actions associated with alternative C that have the potential to impact socioeconomic resources are the same as those described under alternative B, with the following exceptions:

- Species cultivated could include:
 - Permit Area 1: Pacific oysters and European flat oysters,
 - Permit Area 2: Purple-hinged rock scallops and Manila clams
- Production of up to 500,000 pounds of shellfish per year

In 2007/2008, DBOC produced between 16 and 34 percent of the oysters harvested in California and between 13 and 28 percent of the shellfish grown in the state (CDFG 2011a, 2011c, 2011e; PCSGA 2009; Kuiper 2009). During these years, DBOC averaged 451,691 pounds of Pacific oyster meat, only slightly lower than the 500,000 pound limit proposed under this alternative. As such, if the state shellfish market continues to expand, DBOC's share of statewide oyster production would be reduced.

Despite the decrease from the 2010 production level, and based on DBOC employment figures from 2010, it is not anticipated that jobs would be lost.

As described under alternative B, the NPS, through the Office of Valuation Services, has initiated an appraisal process to determine the fair market value of the project area, as directed by Section 124 of PL 111-88.

Housing facilities at DBOC would be the same as under alternative B. Staff would not have to relocate under alternative C; therefore, this alternative would not change housing availability for the region or DBOC staff and their families. The staff who live in DBOC housing would maintain their contributions to the regional economy by spending money at local establishments such as restaurants/bars and retailers.

Overall, alternative C would result in long-term beneficial impacts on regional socioeconomic resources due to the continued operation of a commercial shellfish facility within Drakes Estero for another 10 years. No jobs or housing would be lost and both the Seashore and DBOC would continue to contribute to the regional economy at current levels. Although shellfish production at DBOC would be slightly reduced compared to alternative B, this alternative would result in a long-term beneficial impact to shellfish production in California because DBOC would continue to contribute to the statewide shellfish market, with production similar to recent years (2007-2009).

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to socioeconomic resources. Impacts to socioeconomic resources associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact socioeconomic resources within the project area and region. Actions that have the potential to combine with the impacts of alternative B during the 10-year period of the new SUP include ranching operations, kayaking within Drakes Estero, the proposed California Aquaculture PEIR, and the expansion of mariculture within Humboldt Bay, changes to NOAA aquaculture policies, and economic trends. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial impacts of alternative C would result in a long-term beneficial cumulative impact on regional socioeconomic resources and statewide shellfish production. Alternative C would contribute a noticeable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative C would result in long-term beneficial impacts on socioeconomic resources due to the continued operation of a commercial shellfish facility within Drakes Estero for another 10 years. DBOC would continue to provide employment and housing to DBOC staff and their families. DBOC's contribution to the regional tax base (which is based on production rates) would not change substantially and DBOC would provide a local food source for the region, for an additional 10 years, in quantities similar to current distribution. Additionally, it is assumed that visitor spending at the Seashore would continue at current levels. The cumulative impact on both the regional economy and statewide shellfish production would be long-term beneficial, and alternative C would contribute a noticeable beneficial increment to the cumulative impact.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Actions associated with alternative C that have the potential to impact socioeconomic resources are the same as those described under alternative B, with the following exceptions:

- Level of housing for DBOC staff is uncertain
- Shellfish cultivated could include Pacific oysters, European flat oysters, Olympia oyster, Manila clams, and purple-hinged rock scallops throughout the offshore permit area
- Production of up to 850,000 pounds of shellfish per year

As with the other action alternatives, under alternative D, DBOC would continue to sell shellfish in a manner similar to current conditions, with the following modifications: in addition to Pacific oyster products, DBOC would produce and distribute Manila clams (currently produced at DBOC but only distributed on site), European flat oysters (permitted but not currently produced at DBOC) Olympia oysters (not currently produced at DBOC), and purple-hinged rock scallops (permitted but not currently produced at DBOC). Impacts to socioeconomic resources resulting from the continuation of the commercial shellfish operation for an additional 10 years under alternative D are described as follows.

This alternative would allow DBOC to produce up to 850,000 pounds of shellfish per year. When compared to the 2010 reported production of 585,969 pounds, this alternative would allow an increase of 45 percent. When compared to the production limits established for the other alternatives, alternative C would allow approximately 40 percent more shellfish than under alternative B (production limit set at 600,000 pounds) and 70 percent more than under alternative C (production limit set at 500,000 pounds). Between 1996 and 2010, shellfish production within California was generally steady, averaging approximately 1.6 million pounds per year (CDFG 2011c). If statewide shellfish production remains generally steady for the next 10 years, shellfish produced at DBOC could contribute a larger percentage to the state market. However, if the statewide shellfish market expands, DBOC's share would be generally consistent with current conditions.

As described under alternative B, the NPS, through the Office of Valuation Services, has initiated an appraisal process to determine the fair market value of the project area, as directed by Section 124 of PL 111-88.

As detailed in chapter 2, DBOC has submitted two concepts for what expanded development at the site might look like. Under Option 1, the existing housing facilities would remain; therefore, DBOC staff and their families would experience no impact related to housing. However, based on the most recent proposal from DBOC (DBOC 2011g^{xxviii}), Option 2 of alternative D includes the removal of the three existing on-site mobile homes and one of the permanent homes. This option would result in housing impacts similar to those described in alternative A. Specifically, alternative D would require the relocation of the 15 DBOC staff and their families who currently live in the on-site mobile homes (DBOC 2010j^{xxix}). At the time of report preparation, information pertaining to the total number of residents living in the mobile homes within the project area was not readily available. As described in alternative A, the removal of these housing units would adversely impact those forced to relocate, but the impacts to the region would be limited.

DBOC acknowledges that its concept drawings do not show any worker housing except a manager's residence (the cabin) and has stated that worker housing may be incorporated into the design in the future (DBOC 2011g^{xxx}). The conceptual analysis provided in this document applies only to on-site development. Should housing be provided outside of the project area, a separate review would be required (environmental compliance could not be tiered off this EIS).

In addition, as part of alternative D, the NPS would approve expanded onshore development at a conceptual level. The elements of this alternative are based on DBOC proposals to the NPS during the public scoping and alternatives development processes as well as on DBOC's most recent application to the CCC for a coastal development permit (project description is dated March 3, 2010). The new facilities would provide visitors with the opportunity to view the entire shellfish production process (seed

production to shucking and packing) (DBOC 2011g^{xxxi}). This improvement to visitor experience (described further in the “Impacts on Visitor Experience and Recreation” section of this chapter), could minimally increase annual visitation to DBOC. The installation and/or construction of new facilities would increase expenses for DBOC over the short term (i.e., during the construction period) and could reduce net profits for those years. Given the high cost associated with the amount of new construction proposed by DBOC and the fact that the SUP would terminate in 10 years it may not be economically advantageous for DBOC to fund this level of capital investment in an operation that must terminate in 10 years. However, if construction and demolition work occurs under this alternative (e.g., the demolition of the processing plant and construction of a new two-story processing and interpretive facility associated with alternative D, Option 1, or the construction of the new multipurpose building associated with Option 2), alternative D also would create short-term jobs for local workers.

Overall, alternative D would result in long-term beneficial impacts on regional socioeconomic resources due to the continued operation of a commercial shellfish facility within Drakes Estero for another 10 years. No jobs or housing would be lost and both the Seashore and DBOC would continue to contribute to the regional economy at current levels. This alternative would result in a long-term beneficial impact to shellfish production in California because DBOC would continue to contribute to the statewide shellfish market for another 10 years.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to socioeconomic resources. Impacts to socioeconomic resources associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would be similar to those described under alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact socioeconomic resources within the project area and the region. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include ranching operations, kayaking within Drakes Estero, the proposed California Aquaculture PEIR, the expansion of mariculture within Humboldt Bay, changes to NOAA aquaculture policies, and economic trends. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term beneficial. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial impacts of alternative D would result in a long-term beneficial cumulative impact on regional socioeconomic resources and statewide shellfish production. Alternative D would contribute a noticeable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative D would result in long-term beneficial impacts on regional socioeconomic resources. Option 1 of alternative D would not change the availability of housing for DBOC staff and their families.

In contrast, Option 2 of alternative D, which would include the elimination of four on-site housing units, would have an adverse direct impact on DBOC staff and the families that live on site.

Under both options, DBOC would maintain its contributions to the regional economy in a manner similar to current conditions, for an additional 10 years, with some exceptions.

The potential for increased shellfish production under alternative D could result in an increase in DBOC staff, providing additional jobs for local workers. Although the new facilities at DBOC could minimally increase visitation to shellfish operation, it is assumed that visitor spending associated with the Seashore as a whole would continue at current levels.

The relocated households proposed under Option 2 represent a very small percentage of the total households in the surrounding communities (less than 0.01 percent of the housing in Marin County and 0.4 percent of the homes in Inverness) (U.S. Census Bureau 2005–2009). Therefore, even if all DBOC staff that currently reside in on-site housing move to another community and/or county, the impact on the regional economy would be minimal. Additionally, some short-term jobs would be created once new onshore facilities are approved by the NPS and developed by DBOC. The cumulative impact on the regional economy would be long-term beneficial, and alternative D would contribute a noticeable beneficial increment to the cumulative impact.

Both Option 1 and Option 2 of alternative D would result in long-term beneficial impacts to shellfish production in California because DBOC would continue to contribute to the statewide shellfish market for an additional 10 years. Additionally, the increased production limits proposed under this alternative would allow DBOC to cultivate more diverse and larger quantities of shellfish, including the purple-hinged rock scallop and the Olympia oyster, which are not currently produced at DBOC. These increased production limits could result in DBOC increasing their contribution to the California shellfish market. The cumulative impact on statewide shellfish production would be long-term beneficial, and alternative D would contribute a noticeable beneficial increment to the cumulative impact.

IMPACTS ON NPS OPERATIONS

LAWS AND POLICIES

Direction for management and operations at the Seashore is set forth in NPS *Management Policies 2006* (NPS 2006d), the Seashore's business plan (NPS 2007b), and the Seashore's GMP (NPS 1980). The 2007 business plan identifies and describes the roles of each of the Seashore's five operational functions: management and administration, facility operations and maintenance, law enforcement and visitor safety, resource management, and visitor experience and recreation.

METHODOLOGY

NPS management and operations, for the purpose of this analysis, refer to the quality and effectiveness of NPS staff to maintain and administer Seashore resources and provide for an appropriate visitor experience. This section includes an analysis of the projected need for staff time and materials in

relationship to each of the alternatives. The analysis also considers trade-offs for staff time or the budgetary needs required to accomplish the proposed alternatives. NPS staff were consulted regarding expected staffing and funding needs under each alternative. The impact analysis is based on the current description of NPS operations presented in “Chapter 3: Affected Environment” of this document. The required level of effort is discussed in terms of “full-time equivalent” or FTE, which represents the hours worked by staff. One FTE equals 2,080 hours, the equivalent of one person working full time year-round, or two part-time staff each working six months of the year. This section includes an analysis of both direct and indirect impacts, and considers them over the long-term and short-term.

Intensity Definitions

Minor:	Impacts would be slightly detectable but would not hinder or improve the overall ability of the NPS to provide services, manage resources, or operate the Seashore.
Moderate:	Impacts would be clearly detectable and could appreciably obstruct or improve the ability of the NPS to provide services, manage resources, and/or operate the Seashore.
Major:	Impacts would have a substantial, highly noticeable, potentially permanent influence on the ability of the NPS to provide services, manage resources, or operate the Seashore.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property (including mariculture infrastructure within Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

NPS oversight of the closeout of DBOC operations, removal of personal property and designated structures, and conversion to wilderness would include personnel to monitor closeout procedures and initiate ongoing wilderness monitoring and management efforts. Existing staff efforts associated with the park visitor facilities, including the park road, parking area, and vault toilet, would remain at current levels. The NPS would continue to maintain the existing facilities (a gravel parking lot, a vault toilet, and an interpretive board) for visitors wishing to use Drakes Estero under this alternative. FTE and support costs associated with continued maintenance of these facilities would be similar to current efforts. The annual closure of Drakes Estero to recreational boaters for harbor seal pupping season would remain in effect between March 1 and June 30, and under this alternative, a gate would be installed at the intersection of the existing access road with Sir Francis Drake Boulevard to prevent unauthorized boat access to Drakes Estero during pupping season. The public would still be allowed to access the shoreline areas of Drakes Estero.

During the removal of DBOC personal property and closeout of the site operations, existing NPS staff would provide oversight and support. Contractors may be required to ensure protection of sensitive natural and cultural resource areas during this time. In the long term, increased Seashore law enforcement patrols would be required to monitor the former DBOC property and to enforce the boat closure periods.

Overall, alternative A would result in long-term minor adverse impacts on NPS operations due to efforts associated with monitoring/enforcing Drakes Estero during boat closure periods. These impacts would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact NPS operations at the Seashore. These actions include restoration of the onshore developed area following SUP expiration, monitoring/managing invasive species, fire management plan, maintenance of red-legged frog ponds, moving the vault toilet away from the shoreline, planning and management activities, and coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project).

Although no specific restoration plan for this site has been developed, the NPS would undertake actions to maintain and restore natural conditions at the developed onshore area. Such restoration efforts would be conducted by shifting the efforts currently dedicated to existing administration and management associated with Drakes Estero to planning for restoration purposes. Any restoration efforts and interpretive improvements outside of existing plans would be subject to separate NEPA review and would not result in any changes to existing staffing. Researchers would continue to be allowed to apply for an NPS permit to conduct research within Drakes Estero. Management and administration resources associated with these permit applications would be similar to current levels of effort and would not impact NPS operations.

Monitoring and management of invasive species within the Seashore is an ongoing effort. In particular, the annual survey and response for *Spartina* is ongoing. Additionally, there is now documentation of *Didemnum* growing on the ends of eelgrass blades (Grosholz 2011b), indicating that increased monitoring and management of *Didemnum* may be necessary to protect eelgrass habitat within Drakes Estero. NPS would evaluate treatment methods to control *Didemnum* (no actions currently occur). Ongoing monitoring of the nonnative Manila clam may be conducted as appropriate. The Seashore has been using prescribed fire and mowing treatments to control the nonnative plant Scotch broom (*Cytisus scoparius*) in this fire management unit since 1993 and plans to continue with these treatments (NPS 2006b). These activities are ongoing in 2011, with a project to control broom in the area immediately east of the access road through mowing and controlled burn activities. It is estimated that two six-month seasonal positions would be required to assess and manage the extent of these invasions and longer-term management efforts would likely be necessary. As such, invasive species monitoring and management efforts would result in a long-term, minor, adverse impact on NPS operations.

Planning and management activities, such as the new GMP and Adapting Drakes Beach Visitor Access Facilities to Accommodate Anticipated Coastal Change to Improve Natural Coastal Process Project,

would result in short-term increases in management and administration resources to coordinate planning efforts and develop planning documents. Implementation of these plans also would likely result in a short-term increase in resource management staff to manage project logistics and ensure the protection and preservation of natural and cultural resources.

Other management activities such as the fire management plan, maintenance of red-legged frog ponds, and moving the vault toilet away from the shoreline would have similar impacts. Researchers would continue to apply to the NPS for permits to conduct research within Drakes Estero. Management and administration resources associated with these permit applications would be similar to current levels of effort. Ongoing monitoring of projects such as coastal watershed restoration projects would result in short-term, minor, adverse impacts on resource management staff from implementing and monitoring restoration activities. Ongoing activities such as maintenance of red-legged frog ponds and regular trail maintenance would continue.

Based on the information above, the impacts of past, present, and reasonably foreseeable future actions would be short-term and long-term, minor, adverse. The impacts of these past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative A, would result in a long-term minor adverse cumulative impact on NPS operations. Alternative A would contribute a noticeable adverse increment to the cumulative impact.

Conclusion

Overall, alternative A would result in long-term minor adverse impacts on NPS operations because impacts would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore. Additional NPS staff would be required for monitoring/enforcing Drakes Estero during boat closure periods (estimated approximately 1-2 FTE); however, such efforts would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore. The cumulative impact would be long-term minor adverse, and alternative A would contribute noticeable adverse increment to the overall cumulative impact.

IMPACTS OF ALTERNATIVE B

Impact Analysis

Under alternative B, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact NPS operations include:

- NPS administration of DBOC operations and facilities
- Maintenance of NPS facilities within the project area

DBOC would be required to pay fair market value for the use of federal property, which includes onshore and offshore areas within the permit boundaries. The NPS would evaluate future requests regarding operational and infrastructure changes from DBOC for consistency with the intent of this alternative,

which is to maintain existing conditions. To effectively manage the SUP, NPS would establish a staff position to coordinate park oversight and enforcement of the existing operations.

As a condition of issuance of the SUP, DBOC would surrender their CDFG lease and the NPS SUP would be the only authorization governing the operation. The NPS would oversee and enforce all aspects of the land use operations within the permit area. To effectively manage the SUP, the NPS would establish a staff position to coordinate park oversight and enforcement of the existing operations.

Consistent with the Fish and Game Code, DBOC would be required to maintain an aquaculture registration with CDFG, and CDFG would maintain jurisdiction over the importation of aquatic organisms from other states. CDPH would maintain all responsibilities associated with shellfish water quality and production monitoring and management.

As under current conditions, NPS would continue to enforce closure of Drakes Estero to recreational boaters annually between March 1 and June 30 for the harbor seal pupping season. Only DBOC would be allowed to use boats within Drakes Estero during this four-month period. As part of the increased coordination, the NPS would increase enforcement of the closure to reduce potential disturbance of harbor seals by nonmotorized recreational boaters. DBOC would only operate within the permit area. No boat operations would be authorized outside the permit area without approval by NPS. Current facilities and operations at DBOC would be generally unchanged from existing conditions. As under current conditions, under the new SUP DBOC would be required to maintain safe facilities. NPS would work with DBOC to bring all existing operations and facilities into compliance with the SUP. Any modifications or expansion of existing facilities at DBOC also would be subject to NPS review and approval.

Existing staff efforts associated with the park visitor facilities, including the park access road, parking area, and vault toilet, would remain at current levels. The NPS would continue to maintain the existing facilities (a gravel parking lot, a vault toilet, and an interpretive board) for visitors wishing to use Drakes Estero under this alternative. FTE and support costs associated with continued maintenance of these facilities would be similar to current efforts. The annual closure of Drakes Estero to recreational boaters for harbor seal pupping season would remain in effect between March 1 and June 30.

As discussed above, issuance of a permit under alternative B would require a dedicated staff position to provide oversight and coordinate enforcement of the SUP, resulting in long-term minor adverse impacts on NPS operations because this impact would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to NPS operations in Drakes Estero. Impacts to park operations associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would be similar to those described under Alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact NPS operations at the Seashore. These actions include monitoring/managing invasive species, fire management plan, maintenance of red-legged frog ponds, moving the vault toilet away from the shoreline, planning and management activities, and coastal watershed restoration projects (Geomorphologic Restoration Project and Drakes Estero Road Crossing Improvement Project), as described under alternative A. For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative B would result in a long-term minor adverse cumulative impact on NPS operations. Alternative B would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A, with one noteworthy exception. Although shellfish operations would cease in 2022, the additional 10 years of nonnative shellfish cultivation within Drakes Estero under alternative B may allow these shellfish species to become further established in the Drakes Estero benthic community (purple-hinged rock scallop may be native in larval form, but is not typically found in soft-bottom estuaries such as Drakes Estero). It would also continue to provide a hard substrate upon which *Didemnum* may continue to grow. Prolonging the presence of these nonnative shellfish and associated infrastructure under alternative B could hinder NPS efforts at invasive species management in Drakes Estero and could increase the level of effort required for monitoring and management, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the shellfish operation.

Conclusion

Overall, alternative B would result in long-term minor adverse impacts on NPS operations because this alternative would require establishment of one staff position to coordinate park oversight and enforcement of the existing operations. The NPS would oversee and enforce all aspects of the operation within the permit area. The staff increase under alternative B represents less than 1 percent of the overall FTE employed by the Seashore. These impacts would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore. The cumulative impact would be long-term minor adverse, and alternative B would contribute a noticeable adverse increment to the overall cumulative impact.

IMPACTS OF ALTERNATIVE C

Impact Analysis

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact NPS operations are the same as described under alternative B. The offshore SUP boundaries would be modified to a smaller area; however, DBOC's racks and bags would occupy

the same space as under alternative B. The change in production limit (from 600,000 pounds per year under alternative B to 500,000 pounds per year under alternative C) is also not expected to result in any difference in impacts.

Under alternative C, impacts on NPS operations would be the same as described under alternative B. To effectively manage the SUP, NPS would establish a staff position to coordinate park oversight and enforcement of the existing operations. Existing staff efforts associated with the park visitor facilities, including the park access road, parking area, and vault toilet would remain at current levels and would be the same as described under alternative B.

As described above, the issuance of a new permit under alternative C would require one dedicated staff position to provide oversight and coordinate enforcement of the SUP, resulting in a long-term minor adverse impact on NPS operations because this impact would be slightly detectable but would not obstruct the overall ability of the NPS to provide services, manage resources, or operate the Seashore.

Similar to the other action alternatives, upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to NPS operations in Drakes Estero. Impacts to park operations associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would be similar to those described under Alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact NPS operations at the Seashore. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include monitoring/managing invasive species, fire management plan, maintenance of red-legged frog ponds, moving the vault toilet away from the shoreline, planning and management activities, and coastal watershed restoration projects (Geomorphologic Restoration Project and Drakes Estero Road Crossing Improvement Project). For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term, minor, adverse impacts of alternative C would result in long-term, minor, adverse cumulative impacts. Alternative C would contribute a noticeable adverse increment to the overall cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A, with one noteworthy exception. Although shellfish operations would cease in 2022, the additional 10 years of nonnative shellfish cultivation within Drakes Estero under alternative C may allow these shellfish species to become further established in the Drakes Estero benthic community (purple-hinged rock scallop may be native in larval form, but is not typically found in soft-bottom estuaries such as Drakes Estero). It would also continue to provide a hard substrate upon which *Didemnum* may continue to grow. Prolonging the presence of these nonnative shellfish and associated infrastructure under alternative C could hinder NPS efforts at invasive species management in Drakes Estero and could

increase the level of effort required for monitoring and management, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the shellfish operation.

Conclusion

Overall, alternative C would result in a long-term minor adverse impact on NPS operations because this alternative would require establishment of one staff position to coordinate park oversight and enforcement of the existing operations. The NPS would oversee and enforce all aspects of the operation within the permit area. The staff increase under alternative C represents less than 1 percent of the overall FTE employed by the Seashore. These impacts would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore. The cumulative impact would be long-term minor adverse, and alternative C would contribute a noticeable adverse increment to the overall cumulative impact.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, NPS would issue a new SUP to DBOC for a period of 10 years for continued commercial shellfish operations within and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact NPS operations are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact wetlands include:

- Increased production limit
- New onshore development

Under this alternative, the NPS would consider new onshore development through a tiered, but separate, NEPA process. Alternative D includes concepts for two potential design approaches. Any structures built by DBOC under alternative D would be considered personal property and removal would be required upon expiration of the permit in 2022. Alternative D would cap production levels at 850,000 pounds of shellfish per year, which is a noteworthy increase over alternatives B (600,000 pounds per year) and C (500,000 pounds per year).

Under alternative D, there would be some level of demolition of existing structures and construction of new structures within the onshore permit boundaries. However, the existing NPS facilities and associated operations at the project site would be generally unchanged under alternative D. As described under the other action alternatives, the new SUP would include the condition that DBOC must maintain safe facilities. NPS would work with DBOC to bring all existing operations and facilities into compliance with the SUP. Any modifications or expansion of existing facilities at DBOC also would be subject to NPS review and approval. Issuance of a permit under alternative D would require a dedicated staff position to provide oversight and coordinate enforcement of the SUP and an additional 2-year planning position to coordinate NEPA compliance for the proposed onshore development.

Existing staff efforts associated with the park visitor facilities, including the park access road, parking area, and vault toilet would remain at current levels, as under alternatives B and C.

As described above, alternative D would result in long-term minor adverse impacts on NPS operations because establishment of two dedicated planning and oversight positions, as well as field oversight, would be slightly detectable but would not obstruct the overall ability of the NPS to provide services, manage resources, or operate the Seashore.

Upon expiration of the SUP in 2022, the conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would result in changes in impacts to NPS operations in Drakes Estero. Impacts to park operations associated with conversion of the site from congressionally designated potential wilderness to congressionally designated wilderness would be similar to those described under Alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact NPS operations at the Seashore. Actions that have the potential to combine with the impacts of alternative D during the 10-year period of the new SUP include monitoring/managing invasive species, fire management plan, maintenance of red-legged frog ponds, moving the vault toilet away from the shoreline, planning and management activities, and coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project). For the same reasons discussed in the cumulative impact analysis for alternative A, the impacts of these past, present, and reasonably foreseeable future actions would be long-term minor adverse. The impact of these past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse impacts of alternative D would result in a long-term minor adverse cumulative impact on NPS operations. Alternative D would contribute a noticeable adverse increment to the cumulative impact.

Due to discontinuation of DBOC operations in 2022 and the restoration of onshore facilities, cumulative impacts beyond 2022 would be expected to be similar to the cumulative impacts described under alternative A, with one noteworthy exception. Although shellfish operations would cease in 2022, the additional 10 years of nonnative shellfish cultivation within Drakes Estero under alternative D may allow these shellfish species to become further established in the Drakes Estero benthic community (purple-hinged rock scallop may be native in larval form, but is not typically found in soft-bottom estuaries such as Drakes Estero). It would also continue to provide a hard substrate upon which *Didemnum* may continue to grow. Prolonging the presence of these nonnative shellfish and associated infrastructure under alternative D could hinder NPS efforts at invasive species management in Drakes Estero and could increase the level of effort required for monitoring and management, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite cessation of the shellfish operation.

Conclusion

Overall, alternative D would result in long-term minor adverse impacts on NPS operations because this alternative would require establishment of one dedicated staff position to coordinate park oversight and enforcement of the existing operations as well as an additional staff position to coordinate NEPA

compliance for the proposed onshore development. The NPS would oversee and enforce all aspects of the operation within the permit area. The staff increase under alternative D represents less than 2 percent of the overall FTE employed by the Seashore. These impacts would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore. The cumulative impact on NPS operations would be long-term minor adverse, and alternative D would contribute a noticeable adverse increment to the cumulative impact.

SUMMARY OF IMPACT ANALYSIS

SUSTAINABILITY AND LONG-TERM MANAGEMENT

The NPS is required to consider the relationship between short term uses of the environment and the maintenance and enhancement of long-term productivity (NEPA section 102(2)(C)(iv)). In doing so, the NPS considers the long-term impacts of its actions, and whether its actions involve tradeoffs between immediate use of resources and long-term productivity and sustainability of resources.

Alternative A would support the long-term protection of the park's natural resources by supporting the recovery of the natural ecosystem and all other values for which Drakes Estero was designated by Congress as potential wilderness and for which the Seashore was established. The Seashore is highly valued for its natural setting, especially due to its proximity to the highly developed and densely populated San Francisco Bay Area. The enabling legislation established the Seashore "to save and preserve, for purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped" (PL 87-657). Under alternative A, a new SUP would not be issued and recovery of the natural ecosystem would begin immediately after shellfish operations ceased. This would enhance the sustainability of park resources by supporting long-term ecosystem protection, support natural ecosystem recovery, and provide desirable conditions for restoration.

Alternatives B, C and D would allow for an additional 10 years of commercial shellfish production, which would be a productive use and would provide benefits to the public by producing between 500,000 and 850,000 pounds of shellfish for local consumption and generating income for the local economy. The cultivation of nonnative species for this additional 10 year period poses a risk, however, that these species could establish naturally breeding populations within Drakes Estero. Further, the continued use of offshore infrastructure would maintain the potential for *Didemnum* expansion, and associated mariculture activities (such as infrastructure maintenance, vessel traffic, and harvesting) would pose a risk for further dispersal of this nonnative invasive tunicate. In addition, these alternatives would allow continued commercial use and development instead of restoration for "purposes of public recreational, benefit, and inspiration," as called for in the Seashore's enabling legislation.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

The NPS is required to consider if its actions involve an irreversible or irretrievable commitment of resources (NEPA section 102[c][v]). A resource commitment is considered irreversible if it involves use of and impacts to a non-renewable resource (or a resource renewable only over a long period of time)

such that future options for use of that resource are limited. A resource commitment is considered irretrievable if it involves consumption of resources not renewable or recoverable for future use.

None of the alternatives would result in an irreversible or irretrievable commitment of resources beyond that associated with carrying out park management activities (under all alternatives) or commercial shellfish production operations (for alternatives B, C and D), such as limited amounts of fuel and materials consumption.

Alternatives B, C and D have the potential to result in an irreversible commitment of resources due to the continued risk of nonnative species, especially Manila clam, becoming established within Drakes Estero and the risk of continued spread of *Didemnum*. If these nonnative species cannot be controlled, it would represent an irreversible loss of an otherwise natural ecosystem within Drakes Estero.

UNAVOIDABLE ADVERSE IMPACTS

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA section 102[c][ii]).

Under alternative A, there would be a long-term unavoidable adverse impact on socioeconomic resources due to the reduction in statewide shellfish production. Although no actions associated with this project would mitigate this adverse impact, there is the potential for actions outside this project, such as a potential increase in production levels at other California commercial shellfish operations, to mitigate this loss in statewide shellfish production.

Alternatives B, C and D would result in long-term unavoidable adverse impacts on eelgrass, wetlands, wildlife and wildlife habitat (benthic fauna and fish) due to continued disturbance of sediments in Drakes Estero by another 10 years of DBOC motorboat use. This use also would continue to damage eelgrass plants, which are a component of a vegetated wetland type and which would continue to have indirect but unavoidable adverse impacts on fish habitat. Long-term unavoidable adverse impacts to benthic fauna also would result from the continued cultivation of nonnative species (Pacific oysters, European flat oysters, and Manila clams) within Drakes Estero. The cultivation of these species for an additional 10 years not only provides a continued risk that these nonnative species could establish naturally breeding populations within Drakes Estero, but also provides a large amount of hard substrate on which the invasive tunicate *Didemnum* can grow and continue to spread. This may, in turn, result in long-term unavoidable adverse impacts on eelgrass.

Alternatives B, C, and D would also result in long-term unavoidable adverse impacts on the natural soundscape due to continued DBOC use of noise-generating equipment for an additional 10 years. Human-caused noise emanating from DBOC equipment (e.g., pneumatic drill, oyster tumbler, heavy machinery, trucks, and motorboats) would result in long-term unavoidable adverse impacts on wildlife such as birds and harbor seals and visitor experience and recreation.

Lastly, the continued maintenance of nonconforming structures and uses under alternatives B, C and D within a congressionally designated potential wilderness area would prevent conversion to congressionally designated wilderness for an additional 10 years, a long-term unavoidable adverse impact on wilderness.

ENDNOTES

i. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on March 5, 2011, regarding boat parking and floating dock area dredging.

"The area of shell debris removal is approximately 60' x 30'. The depth of the dredging in this area will vary from 0'0" to approximately 3'0" near the pier. The approximate total volume of dredged material is approximately 100 cubic yards."

ii. Harbin-Ireland 2004, 27: "The decrease in silt content values beneath racks in this study may indicate some sediment erosion is taking place due to the presence of the racks; however the difference . . . is not likely great enough to alter invertebrate community composition."

iii. Wechsler 2004, 13: "Aquatic macrophytes, primarily eelgrass (*Zostera marina*) beds, were the predominant form of subtidal and intertidal biological material in Drakes Estero."

iv. Anima 1991, 42: "In Schooner Bay the channel is somewhat artificial in that it has been scoured out by the constant boat traffic from the oyster operation."

v. Wechsler 2004, 29: "eelgrass growth is restricted directly beneath the oyster racks due to light attenuation."

vi. Harbin-Ireland 2004, 27: "The decrease in silt content values beneath racks in this study may indicate some sediment erosion is taking place due to the presence of the racks; however the difference . . . is not likely great enough to alter invertebrate community composition."

vii. Harbin-Ireland 2004, 35: "The relative abundance of ostracods and bivalves approximately doubles between zero and 50 meters. In addition, the relative abundance of tanaids more than doubles between zero and 10 meters."

viii. Harbin-Ireland 2004, 35: "The relative abundance of ostracods and bivalves approximately doubles between zero and 50 meters. In addition, the relative abundance of tanaids more than doubles between zero and 10 meters."

ix. Harbin-Ireland 2004, 35: "Possible explanations for decreased abundance below oyster racks include increased predation by fish and decapods attracted to oyster cultivation sties by the high densities of oysters (Castel et al. 1989), in addition to the potential inhibition of predatory efficiency in areas of dense eelgrass cover (i.e., control areas) due to the presence of blades and roots which inhibit foraging benthos."

x. Harbin-Ireland 2004, 27: "The decrease in silt content values beneath racks in this study may indicate some sediment erosion is taking place due to the presence of the racks; however the difference...is not likely great enough to alter invertebrate community composition..."

xi. Anima 1991, 42: "Sediment in Drakes Estero ranges between medium grained sand to medium-fine silt, and varies slightly within each branching bay and the central estero area."

xii. Anima 1991, 42: "In Schooner Bay the channel is somewhat artificial in that it has been scoured out by the constant boat traffic from the oyster operation."

xiii. Wechsler 2004, 19: "This trend reemphasizes a possible shift in the fish assemblage to a group of species capable of taking advantage of the rack structure in the water."

xiv. Wechsler 2004, 27: "Analysis of variance tests showed no significant difference in species abundance or species richness at Schooner Adjacent, Schooner Away, or Estero de Limantour."

xv. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

“DBOC also is a popular visitor attraction, bringing approximately 50,000 people each year to West Marin, which increases the demand for goods and services in the area.”

xvi. Letter from Point Reyes National Seashore Superintendent to Executive Director Fish and Game Commission, on June 18, 2004, regarding California Department of Fish and Game lease renewal.

“As we discussed at our last meeting, we are enclosing copies of the legal opinions from our Solicitor's Office about the aquaculture activities of Tom Johnson for your perusal.”

xvii. Letter from Marine Region Aquaculture Coordinator to Johnson Oyster Company on February 2, regarding lease renewal.

“Based on information from Don Neubacher, Superintendent, Point Reyes National Seashore, your existing federal lease will terminate in 2012. At that time the leased land will revert to wilderness designation and your non-conforming use will not be permitted thereafter.”

xviii. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

“DBOC also is a popular visitor attraction, bringing approximately 50,000 people each year to West Marin, which increases the demand for goods and services in the area.”

xix. Letter (with attachments) from Drakes Bay Oyster Company to Point Reyes National Seashore Scientist on March 5, regarding alternate building design. DBOC provided the Drakes Estero Aquaculture Center Concept Design v.1.0, dated April 29, 2009, prepared by Eco Design Collaborative (EDC).

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“The EDC design would also improve the visitor experience and interpretive opportunities by allowing the public to view every step of the shellfish process, from seed production to shucking and packing.”

xxii. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Scientist on November 15, regarding employee list. Provided a list of current staff (as of the date of the letter).

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xxv. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Scientist on November 15, regarding housing.

“DBOC provides five homes with a total of 14 bedrooms for its employees; and in some cases, their families.”

xxvi. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

“DBOC also is a popular visitor attraction, bringing approximately 50,000 people each year to West Marin, which increases the demand for goods and services in the area.”

During EIS preparation, DBOC did not provide documentation to support this visitation estimate.

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