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ENVIRONMENTAL CONSEQUENCES

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ENVIRONMENTAL CONSEQUENCES

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, intensity definitions (negligible, 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.”

FORMAT OF THE ANALYSIS

For each impact topic, laws and policies, methodology, and intensity definitions are presented first to provide context for how the resource topic was evaluated. This framework is followed by three additional sections specific to each alternative: Impact Analysis, Cumulative Impact Analysis, and Conclusion.

LAWS AND POLICIES

Relevant laws and policies are described for each resource.

METHODOLOGY

This section describes methods used for measuring and assessing impacts, intensity definitions specific to each resource, and a discussion of the references used for the analysis. This discussion acknowledges the uncertainty related to the strength of the underlying scientific data, discloses where site-specific information is not available, and summarizes the information used from similar or representative settings that is relevant to evaluating impacts on the resource.

Intensity Definitions

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 negligible, minor, moderate, and major adverse impacts. The CEQ regulations advise (40 CFR 1500.2), and NPS *Management Policies 2006* require, that managers minimize and avoid adverse impacts on park resources. Standard NPS NEPA practice, as reflected in the Director's Order 12 Handbook and elsewhere, thus focuses on mainly such adverse effects. Beneficial effects are discussed and analyzed, wherever present, but generally only in a qualitative manner.

IMPACT ANALYSIS

This section describes the potential impacts of each of the alternatives. This section uses the best available scientific literature applicable to the region and setting to predict the expected impacts of each alternative, including the no-action alternative, using the existing condition (baseline) described in "Chapter 3: Affected Environment" as the starting point for the analysis. As noted by Bass, Herson and Bogdan, "[i]t is easy to confuse the baseline with the no-action alternative" (2001). They go on to explain "[t]he baseline is essentially a description of the affected environment at a fixed point in time, whereas the no-action alternative assumes that other things will happen to the affected environment even if the proposed action does not occur" (2001).

"Chapter 1: Purpose of and Need for Action" provides a summary of the types of references used in preparing the impact analysis. Generally, for this EIS, in cases where site-specific information was not available, references were taken from peer-reviewed scientific literature conducted in similar or representative settings where such references added clarity to the issues addressed. Secondary references were not used for the analysis, unless there was a compelling reason to do so.

CUMULATIVE IMPACT ANALYSIS

The approach to the second section of the analysis, "Cumulative Impact Analysis," is described more fully below, but generally describes the impacts which would result when the potential impacts of the alternatives are added to the impacts of other past, present, and recently foreseeable future actions.

CONCLUSION

The conclusion section provides a summary of the impacts and restates the overall impact "intensity definition." The definition is determined by using the description of the impacts from the "Impact Analysis" and applying an intensity level and duration to those impacts to provide context for the reader in understanding the extent and magnitude of a predicted adverse impact. This allows for comparison of the action alternatives to the no-action alternative, consistent with DOI NEPA regulations at 43 CFR 46.415(b)(1), which state:

> "the analysis 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."

Language such as "would continue to occur" and "would remain altered" is included in the conclusion where appropriate to reinforce the fact that certain impacts being described are not new impacts, rather they are existing impacts that would persist into the future. This is especially true of the action alternatives, where impacts to resources would include both the continuation of existing DBOC operations and facilities in addition to new elements or actions proposed as part of the alternatives.

Additional site specific data may help to refine the conclusions in the EIS and reduce uncertainty regarding the level of impact on the human environment; however, all NEPA analysis is based on a prediction of potential future conditions and, as such, is always uncertain. In lieu of site-specific data, research methods generally accepted in the scientific community and best professional judgment have been used to draw conclusions regarding expected impacts to resources, as guided by CEQ and DOI requirements. The available data provide sufficient information to allow the decision maker to make a reasoned choice among alternatives.

This section also discusses consistency of the impacts of each alternative with relevant law and policy. Although the Secretary's authority under section 124 is "notwithstanding any other law," analysis of such consistency is still helpful.

ANALYSIS PERIOD

Consistent with the establishment of wilderness in Point Reyes National Seashore (PL 94-544 and 94-567) and the Wilderness Act (PL 88-577), the NPS will proceed with conversion of congressionally designated potential wilderness to congressionally designated wilderness upon expiration of authorizations (whether in 2012 or 2022) for a commercial shellfish operation in Drakes Estero. 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 analysis 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 analysis 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 visitor experience and recreation, socioeconomic resources, and NPS operations. The scale used for NPS

operations and visitor experience and recreation is the Seashore boundary. The area of analysis for socioeconomic resources is 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 1 year or longer in duration.

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 report, were approximately 450,000 lbs of shellfish, with Manila clams permitted only in 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 (2009) 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 in the 142 acres of established growing areas in 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 2 to 3 months outside the harbor seal pupping season, March 1 to June 30) and disposed of as appropriate.
  - All bags would be removed from Drakes Estero, including up to 88 acres of bottom bags. This is estimated to take approximately 2 to 4 weeks.
  - Standard BMPs to minimize associated impacts to the environment such as use of a silt curtain would be implemented.
  - Divers would also remove by hand any large debris that had fallen beneath the racks such as strings or large chunks of shell.
  - The timing of the rack removal would occur outside of the harbor seal closure period (March 1-June 30).
- DBOC operations, including motorboat use in Drakes Estero and the operation of pneumatic hammers/drills and other equipment associated with the onshore operations would cease.
- NPS would coordinate and conduct baseline surveys and monitoring of resources to assist with identifying the extent and distribution of target resources including benthic and infaunal communities (tunicates, Manila clams, etc.) and eelgrass.

ALTERNATIVE B

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

- Onshore facilities and infrastructure, including previously unpermitted infrastructure, would be authorized and 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 1,082 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), in Drakes Estero.
  - In 2013, DBOC would repair 50 racks. The analysis assumes that between 50 percent and 75 percent of the rack material associated with those racks would need to be replaced; therefore, between 65,000 and 97,000 linear feet of lumber, not including between 1,700 and 2,500 posts, would be installed in Drakes Estero.
  - In 2014, DBOC would repair 25 racks. The analysis assumes that between 25 percent and 50 percent of the rack material associated with those racks would need to be replaced; therefore, between 14,000 and 29,000 linear feet of lumber, not including between 380 and 750 posts, would be installed in Drakes Estero.
  - Following this repair effort, maintenance of the racks is assumed to add between 1,000 and 2,000 linear feet of lumber to Drakes Estero annually. Vertical posts would be replaced as necessary.
  - Any materials removed from the racks would be disposed of as appropriate.
  - During rack repair, some increase in boat traffic may be required to supplement regular operations.
  - DBOC would use appropriate standard BMPs during removal of dilapidated materials and installation of new rack material, including use of coated wood (also expected to be a permit conditions from the USACE) to reduce impacts on the environment.
- 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).
- Dredging using appropriate standard BMPs 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 2011d[i]); although straightforward calculations indicate that it would be 200 cubic yards.
- DBOC would be required to pay the U. S. fair market value for the use of federal property, which includes onshore and offshore areas in the permit boundaries, as mandated by section 124.
- Pacific oysters and Manila clams could be cultivated in documented shellfish growing areas in 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 (using the rolling 3-year average, inclusive of all harvested species[1]).
- DBOC would operate motorized boats in the established SUP area in compliance with a NPS-approved vessel transit plan.
  - The total area of boat use estimated using available data is approximately 740 acres.
  - DBOC currently operates three motorboats in 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. DBOC has not provided the NPS with information related to size or engine horsepower for the third boat, which has recently been reintroduced into operation (DBOC 2012b[ii]).
  - In combination, DBOC boats operate approximately 8 hours per day, 6 days per week, making approximately 12 round trips per day, although levels of boat operation vary with conditions such as weather and demand (DBOC [Lunny], pers. comm., 2011h, 2012b[iii]).
  - NPS and CDPH have reviewed sampling protocols, intent, and requirements. The current SUP includes language for access to the main channel to sample the sentinel PSP station. Access to any required monitoring station outside the permit area shall be made at flat wake speed within 1 hour of predicted high tide for the area. Flat wake speed means the minimum required speed to leave a flat wave disturbance close astern a moving vessel yet maintain steerageway, but in no case in excess of 5 statute miles per hour (36 CFR 1.4).
- DBOC operations would be subject to the harbor seal protection protocol as established in the 2008 SUP:
  - Boat travel and general operations, including placement of bags, moorings, and installation of floating racks, is prohibited in the established harbor seal protection areas.
  - Closure of the lateral channel in its entirety during the harbor seal pupping season (March 1 to 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, using appropriate standard BMPs such as silt curtains to reduce impacts on the environment.
  - New wooden floating dock (12 feet by 32 feet)
  - New concrete work platform (including sediment basin approximately 55 feet by 24 feet)

[1] The SUP would define the production limit using the average annual harvest over a rolling 3-year period, which would include the current year and the two previous years. For example, production of 600,000, 700,000 and 500,000 pounds over years 1 through 3 would be in compliance with this requirement with an average harvest of 600,000 pounds; however, harvest of 600,000, 700,000 and 600,000 pounds each year for a 3-year average of 633,333 pounds would not. The use of an average is meant to allow DBOC to reasonably account for natural variability in growing conditions and to adjust annual production as necessary. The number of individuals that could be produced under this alternative would depend upon the proportion of species harvested in a given year. The Final EIS uses the conversion for Pacific oyster of 100 oysters per gallon and 8.5 pounds per gallon. Assuming 100 percent oyster harvest, a limit of 600,000 pounds would equate to approximately 7,058,854 individuals. If some other species (e.g., Manila clams) were harvested, the oyster harvest would need to be lowered accordingly to maintain a rolling 3-year average of 600,000 pounds of shellfish produced annually. All references to "annual production" in the action alternatives follow this rolling 3-year average format.

  - New wooden ramps to connect the dock and work platform
  - New conveyor
  - New washing system
- Staff housing would be provided (14 bedrooms)
  - 2 permanent houses
  - 3 mobile homes
- When the new SUP expires, 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.
- NPS would coordinate baseline surveys and monitoring of resources to assist with identifying the extent and distribution of target resources including benthic and infaunal communities (tunicates, Manila clams, etc.) and eelgrass.

ALTERNATIVE C

Under alternative C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations in 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 some 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 (using the rolling 3-year average, inclusive of all harvested species).
- Pacific oysters could be grown on documented shellfish growing areas in the main offshore permit area, Area 1. Purple-hinged rock scallops could only be cultivated in the existing 1-acre plot, Area 2.
- All cultivated Manila clams would be removed.
- DBOC would be responsible for implementing harvest practices intended to minimize fragmentation and loss of *Didemnum* from oysters. This includes modification of current harvest and distribution practices to ensure that oyster strings or bags hosting *Didemnum* are managed in a way that does not distribute *Didemnum* to other areas of Drakes Estero.
- NPS would coordinate baseline surveys and monitoring of resources to assist with identifying the extent and distribution of target resources including benthic and infaunal communities (tunicates, etc.) and eelgrass.
- 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 in 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, site 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.
  - During additional design phases of the new onshore development under alternative D, NPS would work with DBOC to ensure that onshore sound-generating equipment would be housed in new buildings constructed or otherwise enclosed to the extent practicable.
- 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 (using the rolling 3-year average, inclusive of all harvested species).
- Pacific oysters, Manila clams, Olympia oysters, and purple-hinged rock scallops could be cultivated in documented shellfish growing areas in 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 placed in Drakes Estero would be at least approximately 22 acres per year, 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 potentially in visitation may occur.
- NPS would coordinate baseline surveys and monitoring of resources to assist with identifying the extent and distribution of target resources including benthic and infaunal communities (tunicates, Manila clams, etc.) and eelgrass.

  When the new SUP expires, 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 commercial shellfish operations 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 remaining structures, removal of fill from wetland areas, and restoration of tidal conditions to the pond northwest of the developed area through a separate planning process. The Seashore would relocate public access and facilities to a location more appropriate with anticipated sea-level rise, as necessary. Public access to Drakes Estero would be maintained. The following resources could be impacted by the proposed restoration activities: wetlands and other waters of the U.S., 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 in Point Reyes National Seashore, including Drakes Estero between July 1 and February 28 each year (outside of harbor seal pupping season). Of those authorized, a small number currently offer tours in Drakes Estero (an estimated two or three of the companies). In addition, visitors to the Seashore have access to Drakes Estero for kayaking as individuals. Research suggests that kayaking may affect harbor seal behavior (Becker, Press, and Allen 2011; Suryan and Harvey 1999; Calambokidis et al. 1991), cause 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 in Drakes Estero and may limit use by permit. Continued (and potentially increased) use of kayaks and other nonmotorized watercraft (such as canoes or paddle boards) in Drakes Estero has the potential to impact wildlife and wildlife habitat (harbor seals and birds), soundscapes, visitor experience and recreation, and socioeconomic resources.

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 in 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 in the Drakes Estero fire management unit, which is one of three fire management units (out of 11 total in the Seashore) that were established primarily for resource management reasons. Fire management planning in the Seashore has the potential to impact the following resources: water quality and NPS operations (NPS 2006b).

Move Vault Toilet out of Flood Hazard Area. The vault toilet may 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 in the Drakes Estero watershed. According to Baltan (2006) and Zubkousky (2010) the primary source of nonpoint-source pollution in Drakes Estero is from cattle waste from ranches in 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 in the watershed (Baltan 2006; Zubkousky 2010). In addition, other pollution sources include residential septic facilities associated with ranching operations. In 2006, the NPS upgraded a failed septic system at Home Ranch following flooding events that winter. The leachfield was established in an upland area outside of the area subject to flooding. Ranchers in cooperation with the NPS have installed riparian fencing and other BMPs to reduce cattle access to stream habitat. Shellfish harvesting closures triggered by rainfall events have been required in 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-caused Noise Sources (Non-DBOC). Ongoing sources of noise in Drakes Estero (other than those related to DBOC, which are evaluated as an impact topic) such as overflights and the use of cars along Sir Francis Drake Boulevard, have the potential to impact resources in and around the project area. For instance, according to recent data collection, overflights account for 13 percent (in the summer) to 17.6 percent (in the winter) of audible sounds at the PORE004 site located on the bluff of Drakes Estero;

however, the change in median sound levels (L_{50}) due to all aircraft at the PORE004 site is estimated to be small: 1.4 dBA in summer and 1.7 dBA in winter (Volpe 2011). 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 Seashore 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

Some of these projects may involve activities in the Phillip Burton Wilderness. Any action proposed to take place in congressionally designated 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 available on wilderness.net) 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 2009, 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, in 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 Phillip Burton Wilderness, and expansion of tidal habitat to portions of Estero de Limantour through the removal of Muddy Hollow Dam, Limantour Beach Pond Dam, and Glenbrook Dam. The remains of Glenbrook Dam, a breached dam in the wilderness portion of Estero de Limantour were removed in 2009. Minimum Requirements Analysis and Minimum Tool Determination were completed for each of the projects in the Phillip Burton Wilderness. 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 and other waters of the U.S., 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 in the Drakes Estero watershed. The culverts were designed to facilitate restoration of natural hydrologic and geomorphic processes and fish passage in 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 and other waters of the U.S., 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 in state-owned tidelands (CA.gov 2010). 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 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 in 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 on granted tidelands in 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 would be dedicated to conducting pre-permitting studies with the intent of expanding potential shellfish growing areas in 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 (Greenson 2011). Expansion of shellfish operations in 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). This 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 between 2005 and 2011, ranging from 1.99 million visitors in 2005 to 2.25 million in 2008 (NPS 2011a). Due to the recent economic recession, unemployment rates in both the state and Marin County have increased since 2008 (U.S. Department of Labor 2011). As the country comes out of this recession, it is anticipated that increasing population and economic opportunities would 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 MPAs were established in coastal areas between Alder Creek, near Point Arena in Mendocino County, and 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 MPAs were established along the coast of the Seashore. Two of these areas are located in 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). The Fish and Game Code definition of take is "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." MPAs 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 and Other Waters of the U.S.			
Project area	▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project		▪ Restoration of the developed onshore area following SUP expiration
Eelgrass			
Drakes Estero	▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project	▪ Planning and management activities ▪ CDFG MLPA initiative	▪ Planning and management activities ▪ CDFG MLPA initiative
Wildlife and Wildlife Habitat: Benthic Fauna			
Drakes Estero	▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project	▪ CDFG MLPA initiative	▪ CDFG MLPA initiative
Wildlife and Wildlife Habitat: Fish			
Drakes Estero	▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project	▪ CDFG MLPA initiative	▪ 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	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative
Wildlife and Wildlife Habitat: Birds			
Project area	▪ 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	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities ▪ CDFG MLPA initiative	▪ 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	▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project	▪ Planning and management activities ▪ CDFG MLPA initiative	▪ Restoration of the developed onshore area following SUP expiration ▪ Planning and management activities ▪ CDFG MLPA initiative
Coastal Flood Zones			
Project area			▪ Restoration of the developed onshore area following SUP expiration ▪ Moving the vault toilet out of the flood hazard area

TABLE 4-1. CUMULATIVE IMPACTS ANALYSIS (CONTINUED)

Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Water Quality			
Drakes Estero	▪ Fire management plan ▪ Ranching operations ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project	▪ Fire management plan ▪ Ranching operations	▪ Restoration of the developed onshore area following SUP expiration ▪ Fire management plan ▪ Moving the vault toilet out of the flood hazard area ▪ Ranching operations
Soundscapes			
Project area	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities	▪ Restoration of the developed onshore area following SUP expiration ▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities
Wilderness			
Drakes Estero	▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project	▪ Planning and management activities ▪ CDFG MLPA initiative	▪ Planning and management activities ▪ CDFG MLPA initiative
Visitor Experience and Recreation			
Project area	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities	▪ Kayaking ▪ Human-caused noise (other than DBOC) ▪ Planning and management activities	▪ 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	▪ Kayaking ▪ Ranching operations ▪ Economic trends	▪ Kayaking ▪ Ranching operations ▪ Economic trends	▪ Kayaking ▪ Ranching operations ▪ California Aquaculture PEIR ▪ Expansion of mariculture in Humboldt Bay ▪ Change in NOAA Aquaculture Policy ▪ Economic trends
NPS Operations			
Seashore	▪ Fire management plan ▪ Planning and management activities ▪ Coastal Watershed Restoration: Geomorphic Restoration Project ▪ Coastal Watershed Restoration: Drakes Estero Road Crossing Improvement Project	▪ Fire management plan ▪ Planning and management activities	▪ Restoration of the developed onshore area following SUP expiration ▪ Fire management plan ▪ Moving the vault toilet out of the flood hazard area ▪ 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 AND OTHER WATERS OF THE U.S.

LAWS AND POLICIES

DO-77-1 sets the policy framework for the evaluation of NPS projects and their impacts on wetlands (NPS 2002a). This Director's Order implements 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 activities and structures extending into Drakes Estero from the line onshore reached by mean high tide designated as navigable waters of the U.S., must be authorized by USACE pursuant to section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403). These would include all offshore structures (racks) and the dock located at the onshore facilities. Additionally, all activities 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. The USACE issued authorization (now expired) to DBOC for the emergency repair of the dock in 2011 after damage from the March 20, 2011 storm.

Section 404 of the CWA (33 U.S.C. 1344) prohibits the discharge of dredge or fill material into waters of the U.S., including wetlands, except as permitted by the USACE. Waters of the U.S. generally include tidal waters, lakes, ponds, rivers, streams (including intermittent streams), and wetlands. In a letter to NPS dated November 16, 2010, USACE stated:

> "The aquaculture activities are in 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)

Rules for implementing section 404 of the CWA are found in 33 CFR 320-330. Under these rules, the USACE has established general permits for certain activities across the nation believed to cause minimal impacts to the aquatic environment. These general permits (called Nationwide Permits) are reviewed every 5 years for revocations or modifications of certain activities. The most recent changes to the Nationwide Permits (NWPs) were released as a Final Notice on February 21, 2012 (33 CFR 330). One such NWP is *Commercial Shellfish Aquaculture Activities* (NWP # 48). The USACE's decision to issue this permit is based on actions believed to "result in minimal adverse environmental effects to the environmental criteria established under the CWA. The shellfish populations supported by the activities

authorized by this Nationwide Permit help support the objective of the CWA because they improve water quality through the conversion of nutrients into biomass (i.e. shellfish growth) and the removal of suspended materials through filter feeding." (Federal Register/Vol. 77, No. 34, pages 10228-10229). This permit authorizes "the installation of buoys, floats, racks, trays, nets, lines, tubes, containers, and other structures into navigable waters of the U.S. This permit also authorizes discharges of dredged or fill material into waters of the U.S. necessary for shellfish seeding, rearing, cultivating, transplanting, and harvesting activities." This permit does not restrict the number of structures related to shellfish operation equipment placed in waters or secondary impacts resulting from daily shellfish operations. However, if the proposed action would take place in or adjacent to eelgrass beds, regional USACE conditions require that the landowner notify the USACE in advance of beginning the work (in accordance with General Condition No. 31). This notification must include a compensatory mitigation plan, habitat assessment, and extent of proposed project impacts to eelgrass beds. NWP 48 does not allow: a) the cultivation of non-indigenous species unless that species has been previously cultivated in the waterbody; b) the cultivation of an aquatic nuisance species as defined in the Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990; or c) attendant features (docks, boat ramps, etc.), or d) the deposition of shell waste back into waters of the U.S. The decision whether a project qualifies for a NWP 48 lies with the USACE. Mariculture operations that do not qualify for this NWP are required to secure an individual permit subject to the CWA section 404 permit process. DBOC has not submitted an application to the USACE at this time.

The California State Water Resources Control Board is the regulatory agency that oversees state water quality certification under section 401 of the CWA. The California State Water Resources Control Board is tasked with reviewing the entire NWP program implemented by the USACE to determine which NWPs may or may not meet state water quality certification. The California State Water Resources Control Board San Francisco Bay Regional Water Quality Control Board has denied without prejudice state water quality certification for mariculture projects that may qualify for NWP 48 (CSWRCB 2012). As a result, commercial shellfish applicants must submit a separate section 401 certification application to their regional water quality control board. For DBOC, a permit application would be submitted to the San Francisco Bay Regional Water Quality Control Board for its review.

The CCC oversees implementation of the CZMA. This agency reviews all USACE permit actions to ensure compliance with the CZMA. Upon review of the recent changes in the NWPs, the CCC issued a letter on April 11, 2012, to the USACE that explains the coordination process between the CCC and USACE when a NWP notification is submitted by an applicant. In that letter, CCC states that "A NWP will not be valid for any qualifying activity until the Commission either concurs with a consistency certification or waives the requirement" (CCC 2012c). If the CCC determines that consistency certification is required, an applicant would need to submit an application for a coastal development permit consistent with the California Coastal Act.

METHODOLOGY

This section is focused primarily on the physical impacts on intertidal wetlands and other waters of the U.S. and their functions from the actions that would potentially occur under each alternative. Wetlands and other waters of the U.S. discussed in this section include subtidal areas, intertidal mudflats, intertidal emergent wetlands, and a pond adjacent to the onshore facilities. Specific discussions for impacts on water quality,

subaquatic vegetation (eelgrass), and fauna (benthic organisms, mammals, amphibians, invertebrates, fish, and birds) that reside in wetlands and other waters of the U.S. are discussed in the appropriate impact topic sections. Information from primary literature sources (i.e., those that satisfy the criteria for "primary references" as described in Chapter 1: "References Used for Impact Analysis") was used, particularly published research in areas with a similar setting as Drakes Estero. This was supplemented with the analysis and conclusions of the NAS review on wetlands (NAS 2009).

Typically, impacts on wetlands and other waters of the U.S. are measured in terms of land area (e.g., acres, square feet, etc.) for each action such as the filling or dredging of wetlands. In assessing impacts for this EIS, a determination of exact acreage cannot be quantified for alternatives B, C, and D because materials placed in wetlands and other waters of the U.S. (e.g., floating bags, anchors, bottom bags) would change day to day over the course of the 10 year permit period. Approximate quantifications are provided in the analysis below based on information provided by DBOC on the spatial extent of its operations. For the most part, the types of actions performed by DBOC in wetlands and other waters of the U.S. are not expected to vary greatly between alternatives B, C, and D. It can be assumed, however, that slight differences in the amount of materials placed in wetlands and other waters of the U.S. may occur between the alternatives based on production limits, but this difference is unknown.

Intensity Definitions

Negligible: The impact is not detectable or measurable.

Minor: Impacts on wetlands and other waters of the U.S. would be slightly detectable and localized (affecting a small portion of the wetlands and other waters of the U.S. in the project area), and would not affect the overall structure, processes, or functions of the wetlands and other waters of the U.S.

Moderate: Impacts on wetlands and other waters of the U.S. would be readily apparent and would affect the structure, processes, and/or functions of the wetlands and other waters of the U.S. in the project area.

Major: Impacts on wetlands and other waters of the U.S. would be readily apparent and would severely alter or completely eliminate the structure, processes, or functions of the wetlands and other waters of the U.S. in the project area.

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 infrastructure associated with commercial shellfish operations in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Under this alternative, removal of 5 linear miles (equivalent to 7 acres of offshore racks) and up to 88 acres of bag infrastructure associated with the 142 acres of the permitted culture beds would allow natural wetland processes (vegetation and benthic organisms) to restore and resume. Specifically, removal of

oyster culture bags from the 88 acres of permitted areas occupied by nonvegetated mudflats and sandbars in Drakes Estero would allow benthic organisms to recolonize the space previously occupied by the bags (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. Removal of offshore infrastructure from Drakes Estero would promote the growth and spread of eelgrass in areas below the racks (see Eelgrass section). Dismantled racks would be loaded by boat and transported to the onshore facility for offsite disposal. Standard BMP practices would be employed during dismantling activities to reduce sediment disturbances and water turbidity levels.

Marine debris from damaged mariculture infrastructure has become dislodged and found floating in Drakes Estero or washed up on mudflats and shorelines. Under this alternative, wetlands and other waters of the U.S. would be further enhanced by eliminating the potential for mariculture debris pollution.

Temporary local adverse impacts across 88 acres of E2US wetlands (estuarine, intertidal, unconsolidated shore, sand/mud) would occur while DBOC bags and trays are being removed. This would be a single event lasting approximately 2 to 3 months as workers exit boats and walk across the mudflats during low tide to retrieve the bags, trays, lines, and weights. Sediments in areas of foot traffic would become loosened and suspended into the water column during the next ebb tidal cycle. Disturbances to the Drakes Estero subtidal aquatic bottom would occur during removal of the approximately 4,700 posts (2-inch by 6-inch boards) that support the 7 acres of shellfish racks. 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 over the 2 to 3 month period (Newell 2004; Newell and Koch 2004).

Onshore operations would cease under alternative A, and DBOC equipment and personal property would be removed using standard sediment control BMPs. The main residence and processing plant would remain as NPS property.

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 and other waters of the U.S. in Drakes Estero due to the termination of propeller damage to E2US and E1/E2AB wetlands (estuarine, intertidal and subtidal, 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 and other waters of the U.S. 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 and other waters of the U.S. This action would provide for the restoration of a small portion of the Drakes Estero beach wetlands (E2US2) by allowing sediment sorting and foraging/loafing areas for shorebirds.

The California Climate Change Center report (Heberger et al. 2009) and Cayan et al. (2009) suggest the potential of sea level rise due to climate change could reach a rate of 3 to 4.5 feet by 2100, which is equivalent to a rate of 5.9 inches over the next 10-years at the high end. Based on this prediction, portions of intertidal vegetated wetlands in Drakes Estero would convert to a subtidal zone of year-round

inundation adversely affecting normal hydrophytic plant life cycles and habitats. Marsh vegetation would attempt to migrate landward as new intertidal areas are formed. The extent of intertidal mud flats would become smaller in acreage in Drakes Estero while subtidal areas and habitat for eelgrass would increase in size. Actions posed under alternative A are not expected to contribute to the long-term, predicted impacts to wetlands from climate change and sea level rise.

As described above, alternative A would result in long-term beneficial impacts on wetlands and other waters of the U.S. because the removal of commercial shellfish infrastructure would allow natural processes to resume in areas where these structures displace natural wetlands. Impacts related to operations of motorboats would also cease. Alternative A would result in short-term minor adverse impacts because removal of shellfish infrastructure would cause localized increases in sedimentation that would last 2 to 3 months.

Cumulative Impact Analysis

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

Efforts associated with recent coastal watershed restoration projects in 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 and other waters of the U.S.; therefore resulting in long-term beneficial impacts on wetlands and other waters of the U.S. in 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 and other waters of the U.S. in 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 and other waters of the U.S., in the project area. Structures, processes, and functions of the wetlands and other waters of the U.S. would not be permanently affected as a result of actions from alternative A. However, climate change over the long term may result in sea level rise and the year-round inundation of current intertidal marsh. Vegetated wetlands in Drakes Estero occupy available habitat in the upper bays, and while tidal vegetation has the ability to shift with sea level rise, there is little room for vegetation to shift landward along much of the Drakes Estero shoreline due to the steep sideslopes of the surrounding terrain. The removal of personal property would increase the potential that approximately 3.8 acres of the project area

could be converted back to historical wetland habitat at the onshore facilities. The removal of approximately 7 acres of racks and up to 88 acres of bags from nonvegetated sandbars and mudflats in Drakes Estero would allow benthic organisms and eelgrass in Drakes Estero to recolonize the space previously occupied by the commercial shellfish operation infrastructure (see "Impacts on Eelgrass" and "Impacts on Wildlife and Wildlife Habitat: Benthic Fauna" sections). 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 currently available for use by DBOC. The reduction of propeller-caused turbidity in the water column also would result in increased sunlight penetration and therefore increased primary production.

The removal of racks, including approximately 4,700 posts (2-inch by 6-inch boards), and the removal of bags from up to 88 acres of mud flats would result in short-term minor adverse impacts on wetlands and other waters of the U.S. because of temporary bottom disturbances. Standard BMPs would be used during the removal of racks to minimize sediment disturbances and water turbidity. The increase in turbidity would be highly localized and would occur over a two to three month period. Governmental permit authorization from the USACE would not likely be required. The cumulative impact would be long-term and beneficial, and alternative A would contribute an appreciable beneficial increment to the cumulative impact.

With respect to wetlands and other waters of the U.S., alternative A would be 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 the 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 in and adjacent to Drakes Estero. Actions associated with this alternative having the potential to impact wetlands and other waters of the U.S. include:

- Use and maintenance of shellfish racks, floating bags/trays, and bottom bags in Drakes Estero
- Continued motorized boat traffic
- Installation of a new dock, including dredging

Under alternative B, DBOC would have access to up to 84 acres of tidal mudflats and sandbars for bags and trays. DBOC would continue to cultivate shellfish, until 2022, with a production limit of 600,000 pounds per year (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 and other waters of the U.S. from the continuation of commercial shellfish operations in Drakes Estero 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 culture beds in intertidal wetlands and subaquatic habitats, resulting long-term adverse 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. This is due to the presence of bottom bags, cluster culture for shell hardening, anchors for bag lines lying on the bottom substrate, and approximately 5 miles (7 acres) of racks. Under this alternative, DBOC would replace or repair 50 racks in 2013 and 25 racks in 2014. DBOC has previously reported that 50 racks totaling 3.75 acres were identified as "Needs repair – Inactive." These racks are in relatively poor condition, and it is estimated that 50 to75 percent of the materials making up the racks would need replacement. This would result in the installation of between 1,700 and 2,500 posts in Drakes Estero in 2013, and between 380 and 750 posts in 2014. The installation of these posts would result in a localized, temporary disturbance of sediment.

Currently, a portion of the floating culture is conducted at those racks in need of repair, using either existing rack posts for tie-downs or concrete blocks as anchors (DBOC [Lunny], pers. comm., 2011h and 2012b[iv]). Under this alternative, racks would be completely reconstructed in the same footprint, and once racks are repaired, floating culture adjacent to racks is expected to continue. Currently, some anchors are placed in areas occupied by eelgrass adjacent to racks. This alternative calls for the cultivation of purple-hinged rock scallops using floating bags and/or trays at the 1-acre site known as Permit Area 2 where no racks are located. Thus, it is assumed new floats and anchors would be installed at this location. For each of these areas, as anchors are retrieved and replaced when floating culture is maintained, sediment and eelgrass disturbances to the Estero bottom are expected resulting in localized adverse impacts to waters of the U.S. Details of the work would be presented to the USACE as part of the section 404 and section 10 permitting process.

Bottom bags containing Pacific oysters are placed on beaches and mudflats for approximately 9 months after transfer from racks and floating bags. Bottom bags are turned approximately once every month whereas 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 or other waters of the U.S. would be permanently lost from bag and rack use. 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 bags or clusters are 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).

The offshore shellfish operation has historically used rack and culture bag components such as floats, spacers, and tubes that may unintentionally become dislodged and deposited in other mudflats and shorelines in Drakes Estero. While realizing this as an ongoing possibility, the degree and intensity to which materials become dislodged in the future is not measurable. Intertidal wetlands that receive loose debris, however, would incur localized, impacts. Section 7(b) of the existing SUP states that the "permittee will make best efforts to remove debris associated with aquaculture production operations including wood from racks, plastic spacers, unused shellfish bags, shellfish shells, and any other associated items" (NPS 2008b). A permit to continue commercial shellfish operations in Drakes Estero

would again be conditioned upon the requirement to regularly clean up loose debris, resulting in temporary adverse impacts to mudflats and shorelines as workers access these areas to collect the loose debris. Adverse impacts to wetlands and other waters of the U.S. would also be expected to result from DBOC cleanup procedures should workers disturb the soft bottom of Drakes Estero when retrieving loose debris from intertidal mudflats. However, these impacts are not expected to cause a noticeable increase in disturbances and sedimentation in wetlands and other waters of the U.S.

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 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 and other waters of the U.S. may occur from refuse and runoff entering the estuarine intertidal unconsolidated shore (E2US2), as well as continued routine maintenance of docks, tanks, and the washing area. A mobile residence located directly on the bank of the pond would remain in its current location, resulting in long term disturbances to the pond shoreline and potential accidental discharge of materials into the water from the residence porch directly situated next to the water. The accumulation of shell refuse material has the potential to encroach into the beach shoreline if not hauled to an offsite location. This would result in the covering of habitat that would otherwise be available for intertidal wetland plant species.

Dredging of the E2US mudflat 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 low-tide depth of 3 feet. This would result in the removal of approximately 200 cubic yards of sediment from the intertidal area under the dock. Installing a silt curtain around the work area and restricting work to occur only during low tide would likely be mitigating requirements of agency permitting. In the silt curtain, dredging activities would cause the temporary suspension of soil particles in the water column; however, suspended solids inadvertently escaping the silt curtain 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.

Alternative B would incur changes to wetlands and other waters of the U.S. as a result of climate change and sea level rise as described under alternative A.

As described above, alternative B would result in long-term moderate adverse impacts to wetlands and other waters of the U.S. because infrastructure placed in waters would be readily apparent and would affect the structure, processes, and/or functions of the wetlands and water of the U.S. in the project area for an additional 10 years. Alternative B would also result in short-term minor adverse impacts during normal operations to manage culture bags, trays and racks. Also, dredging around the dock would result in the localized movement of suspended sediment lasting up to a week. Installation of new posts during rack repair would take a few months (outside of seal pupping season) in 2013 and again in 2014. This would also cause a localized increase in sedimentation; a short-term minor adverse impact.

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 and other waters of the U.S. in Drakes Estero. Impacts to wetlands and other waters of the U.S. 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 and other waters of the U.S. in 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 in 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 and other waters of the U.S. 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 and other waters of the U.S. under alternative B would be short-term, minor, and adverse and long-term, moderate, and adverse. In the 138 acres of documented culture beds, bottom bags with anchors and floating lines on up to 84 acres of tidal mudflats/sandbars and 5 miles (7 acres) of racks with floating bags/trays and anchors in subaquatic habitats would continue to occupy 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. Impacts associated with these offshore structures would include intermittent disturbances to mudflats and sandbars from the placement and rotation of bags/trays, lines and anchors, DBOC staff walking across the mudflats/sandbars, and boat propellers and hulls scraping the bottom sediment. The impacts associated with these actions would be slightly greater than alternative C but less than those described under alternative D. Onshore operations may cause a minimal decrease in wetland functions and values if refuse and runoff along the shoreline is not collected and hauled off site. No wetlands or other waters of the U.S. would be permanently converted to uplands under this alternative; however, impacts would be readily apparent and would affect the structure, processes, or functions of the wetlands and other waters of the U.S. for an additional 10 years. Temporary impacts would be associated with dredging under the new dock. Dredging would occur in a 30-by 60-foot area at the dock. Approximately 1,700 to 2,500 2-inch by 6-inch posts would be installed outside harbor seal pupping season during 2013, and approximately 380 to 750 posts would be installed outside the harbor seal pupping season in 2014. Dredging and rack installation and repair would adversely impact the silted

bottom of Drakes Estero. The post installation and rack repair would be conducted over a few months in each year, and impacts from dredging and post installation and rack repair would be expected to last one week (from disturbance) due to a localized increase in suspended sediments. The cumulative impact would be long-term, moderate, and adverse, and alternative B would contribute an appreciable adverse increment to the cumulative impact.

Prior to undertaking any new or replacement activities under this alternative, DBOC would be responsible for obtaining all applicable permits, and complying with all permit conditions. By obtaining state and federal permits and complying with their conditions, DBOC would ensure that alternative B is consistent with relevant law and policy related to management of wetlands and other waters of the U.S. DBOC's commercial shellfish operations and any dredge or fill activities in the waters of the U.S. (including Drakes Estero and the pond behind the mobile homes) are subject to permitting by USACE, San Francisco Bay Regional Water Quality Control Board, CCC, and NMFS. DBOC has received written confirmation that shellfish operations fall in USACE jurisdiction and a permit application is required to ensure that DBOC activities comply with USACE regulations. The letter goes on to note that, if an individual permit is required, DBOC will need to "demonstrate to the USACE that any proposed fill is necessary because there are no practicable alternatives, as outlined in the EPA's section 404(b)(l) Guidelines" (USACE 2010).

NWP 48, described under "Laws and Policies" in this section, authorizes "discharges of dredged or fill material in waters of the U.S. or structures or work in navigable waters of the U.S. necessary for commercial shellfish aquaculture operations in authorized areas" (33CFR 330[B][48]), provided notification is submitted to the USACE and includes a compensatory mitigation plan, habitat assessment, and assessment of impacts to eelgrass. Dredging the area around the dock and installing a new dock would not qualify for the NWP 48, and would require a separate USACE permit.

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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands and other waters of the U.S. are the same as described under alternative B. The offshore SUP boundaries would be modified to a slightly 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, although the overall acreage of shellfish growing beds and racks would be the same. The effort with respect to boat trips may be slightly reduced from conditions described under alternative B; however, the difference in production level is not expected to result in any difference in impacts to wetlands and other waters of the

U.S. Associated impacts to wetlands and other waters of the U.S. resulting from onshore operations and sea level rise 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 and other waters of the U.S. in the project area because impacts would be readily apparent and would affect the structure, processes, and functions of the wetlands and other waters of the U.S. in the project area for an additional 10 years. In addition, 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. Installation of new posts during rack repair taking place for a few months in 2013 and again in 2014 would also cause a localized increase in sedimentation, a short-term adverse impact. Anchors used for floating culture would continue to be used around racks as described under alternative B, and purple hinged scallops will be grown in new floating bags with anchors in Permit Area 2 where no racks occur.

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 and other waters of the U.S. in Drakes Estero. Impacts to wetlands and other waters of the U.S. 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 and other waters of the U.S. in 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 and other waters of the U.S. 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 and other waters of the U.S. 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 and other waters of the U.S. under alternative C would be short-term, minor, and adverse and long-term, moderate, and adverse. Actions associated with the placement of bottom bags on up to 84 acres of tidal mudflats/sandbars and 7 acres of subaquatic habitat for the racks would continue to disturb 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. Racks would be replaced on a schedule of 50 racks in year 2013 and 25 racks in year 2014. The replacements would occur over a few months in each year. Floating culture would likely continue, either attached to racks or using concrete anchors adjacent to racks, but at a reduced level compared to existing operations. Therefore, impacts to wetlands and other waters of the U.S. would be slightly reduced compared to alternative B. Of the 138 acres available for use, bottom bags have been placed on a rotational basis 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 than the physical presence of structures in wetlands and other waters of the U.S., additional impacts would include intermittent 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 minimal decrease in wetland functions and values if refuse and runoff along the shoreline is not collected and hauled off site. No wetlands or other waters of the U.S. would be permanently converted to uplands under this alternative; however, impacts would be readily apparent and would affect the structure, processes, and/or functions of the wetlands and other waters of the U.S. in the project area for an additional 10 years. Temporary impacts would be associated with dredging under the new dock in a 30- by 60-foot area where the old dock is located and the installation/replacement of new rack infrastructure, including between 1,700 and 2,500 2-inch by 6-inch posts in 2012 and 380 to 750 posts in 2014. These actions would adversely impact the silted bottom of Drakes Estero due to a localized increase in sedimentation during the period of construction. The cumulative impact would be long-term, moderate, and adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

Prior to undertaking any new or replacement activities under this alternative, DBOC would be responsible for obtaining all applicable permits and complying with all permit conditions. By obtaining the relevant state and federal permits and complying with their conditions, DBOC would ensure that alternative C is consistent with relevant law and policy related to the management of wetlands and other waters of the U.S. DBOC's commercial shellfish operations and any dredge or fill activities in the waters of the U.S. (including Drakes Estero and the pond behind the mobile homes) are subject to permitting by USACE, San Francisco Bay Regional Water Quality Control Board, CCC, and NMFS. For the reasons described under alternative B, dredging the area around the dock and installation of a new dock would not qualify for the NWP 48, and would require a separate USACE permit.

USACE has provided written notification to DBOC that the commercial shellfish activities in waters of the U.S. are regulated by USACE and has advised DBOC to submit an application to ensure that its activities comply with USACE regulations. 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)(l) 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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact wetlands and other waters of the U.S. are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact wetlands and other waters of the U.S. include:

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

Similar to alternatives B and C, DBOC would have up to 84 acres of intertidal mudflats and sandbars available for bottom bag placement and 7 acres of racks in subaquatic habitats in Drakes Estero under this alternative. Impacts due to dislodged mariculture debris would be the same as those as described under alternative B. For the past two years, approximately 22 acres have been planted annually on a rotational basis. Under this alternative, DBOC may increase shellfish production up 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 and other waters of the U.S. compared to alternatives B and C; however, this amount is undetermined. DBOC currently uses floating culture anchored to existing racks and concrete anchors placed on the Estero bottom adjacent to racks, and this activity would continue under this alternative. DBOC proposes to grow purple hinged scallops as part of this alternative that could require new floating bags and anchors. However, the 1-acre area known as Permit Area 2 would not be used to culture shellfish, as compared to alternatives B and C. Overall, impacts on wetlands and other waters of the U.S. from offshore operations could be highest under this alternative. Any additional floating bags and the placement of bottom 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 associated impacts on wetlands and other waters of the U.S. would be the same as those described under alternative B, with two additions. Alternative D would include the installation of dual 1,050-foot long, 4-inch diameter black PVC pipes to serve as the intake pipeline extending from the onshore facility into Drakes Estero to support the oyster processing operations. Dual pipes are required so that one pipe can remain in operation during times when the other pipe is maintained and cleaned. The dual pipes would be anchored by 10-foot spaced concrete blocks buried under the Estero bottom by hand (DBOC 2012b[v]). This action would be considered a discharge of fill material in waters of the U.S. and a long-term impact to subtidal wetlands. The pipe would be expected to lie on the estuary bottom with minimal fill, impacting less than 0.1 acre of wetlands or other waters of the U.S., and there would be no loss (i.e., permanent conversion to uplands) of wetlands or other waters of the U.S. Alternative D includes two alternative building design plans presented by DBOC for improvements to the onshore facilities. Both of the onshore alternatives would call for the removal of some structures to be replaced by modern

buildings on upland areas. No new structures would encroach into wetlands or other waters of the U.S. The purpose of the new structures would be to serve multiple functions, including housing new setting tanks, provide a more modern working area for processing shellfish, and upgrade the interpretive center. Each building plan 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 implementing standard BMPs, such as installing silt fencing/hay bales along the shoreline. Construction of the new building may have temporary minor adverse impacts on wetlands and other waters of the U.S. by increasing local turbidity levels from runoff 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 and other waters of the U.S.

Alternative D would incur changes to wetlands and other waters of the U.S. as a result of climate change and sea level rise as described under alternative A.

As described above, alternative D would result in long-term moderate adverse impacts to wetlands and other waters of the U.S. in the project area because impacts would be readily apparent and would affect the structure, processes, and functions of the wetlands and other waters of the U.S. in the project area 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. Installation of new posts during rack repair taking place for a few months in 2013 and again in 2014 would also cause a localized increase in sedimentation, a short-term minor adverse impact.

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 and other waters of the U.S. 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 and other waters of the U.S. in 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 and other waters of the U.S. 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 and other waters of the U.S. under alternative D would be short-term, minor, and adverse and long-term, moderate, and 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. Racks would be replaced or repaired, and the use of floating culture would continue adjacent to racks resulting in the use of concrete anchors. In addition to the physical objects placed in wetlands and other waters of the U.S., other impacts would include intermittent 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 those under alternatives B and C but are still expected to be at a moderate level. As under alternatives B and C, onshore operations may cause a minimal decrease in wetland functions and values if refuse and runoff along the shoreline is not collected and hauled off site. No wetlands or other waters of the U.S. would be permanently converted to uplands under this alternative; however, impacts would be readily apparent and would affect the structure, processes, and/or functions of the wetlands and other waters of the U.S. in the project area for an additional 10 years. Temporary impacts include dredging under the new dock (in a 30-by 60-foot area) at the onshore facilities and the installation/replacement of new rack infrastructure including between 1,700 and 2,500 2-inch by 6-inch posts in 2013 and 380 to 750 posts in 2014. DBOC would also place a new 1,050-foot water collection pipeline along the bottom of Drakes Estero using concrete anchors. The construction of a new processing facility would occur on existing uplands. These actions are expected to result in minimal short-term, adverse impacts due to an increase in local turbidity levels. The cumulative impact would be long-term, moderate, and adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

Prior to undertaking any new or replacement activities under this alternative, DBOC would be responsible for obtaining all applicable permits and complying with all permit conditions. By obtaining relevant state and federal permits and complying with their conditions, DBOC would ensure that alternative D is consistent with relevant law and policy related to management of wetlands and other waters of the U.S. DBOC's commercial shellfish operations and any dredge or fill activities in the waters of the U.S. (including Drakes Estero and the pond behind the mobile homes) are subject to permitting by USACE, San Francisco Bay Regional Water Quality Control Board, CCC, and NMFS. Installation of the intake pipe, installation of a new dock, and dredging the area around the dock would require USACE permit authorization. NWP 48 (*Commercial Shellfish Aquaculture Activities*) was issued on February 21, 2012 with modifications. This permit authorizes "discharges of dredged or fill material in waters of the United States or structures or work in navigable waters of the United States necessary for commercial shellfish aquaculture operations in authorized areas" (33CFR 330[B][48]). Dredging the area around the dock and installing a new dock would not qualify for NWP 48, and would require a separate USACE permit.

USACE has provided written notification to DBOC that the activities are in USACE jurisdiction and has advised DBOC to submit a permit application to ensure that DBOC activities comply with USACE regulations. 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' Section 404(b)(l) 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 U.S. afforded additional consideration under the CWA section 404(b)(1) guidelines developed by EPA. The guidelines are the environmental standards used by USACE in the evaluation of permits for the discharge of dredged or fill materials 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 U.S. 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. The most recent changes to the Nationwide Permits were released as a Final Notice on February 21, 2012 (33 CFR 330), and regional conditions to Nationwide Permit activities have been promulgated by the San Francisco District Office of the USACE. If the proposed action would take place in or adjacent to eelgrass beds, regional USACE conditions require that the landowner notify the USACE in advance of beginning the work (in accordance with General Condition Number 31). This notification must include a compensatory mitigation plan, habitat assessment, and extent of proposed project impacts to eelgrass beds. Further, as discussed under the "Impacts on Wetlands and Other Waters of the U. S." section above, the California State Water Resources Control Board has denied without prejudice CWA section 401 state water quality certification for mariculture projects that may qualify for the Nationwide Permit 48 (San Francisco Bay Regional Water Quality Control Board 2012). As a result, even if a project qualifies for Nationwide Permit 48, applicants like DBOC must submit a separate section 401 Certification application to the San Francisco Bay Regional Water Quality Control Board for its review (San Francisco Bay Regional Water Quality Control Board 2012). Further, as stated by the CCC (2012c), a "NWP will not be valid for any qualifying activity until the Commission either concurs with a consistency certification or waives the requirement." NPS has a commitment to regional conservation planning. NPS *Management Policies 2006*

for biological resource management (NPS 2006d, section 4.4 et seq.) also states, "in addition to maintaining all native plants and animal species and their habitats inside the parks, the Service will work with other land managers to encourage the conservation of the populations and habitats of these species outside parks wherever possible. To meet its commitments for maintaining native species in parks, the Service will cooperate with states, tribal governments, the U.S. Fish and Wildlife Service, NOAA fisheries, and other countries, as appropriate to…participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d)

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 the entire State of California have been drafted by the NMFS and have been released for public review and comment (77 Federal Register 47 [March 9, 2012], pp. 29150-29151) Although the California Eelgrass Mitigation Policy has not been officially adopted for use by the agencies, the guidelines in that policy are based on the Southern California model. For coastal projects requiring review by NMFS, USFWS, and/or CDFG, this policy will provide the standardized interagency guidance on mitigating adverse impacts to 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. In addition, mitigation guidelines specify the replacement of impacted eelgrass habitat at a ratio of 1.2:1 (as stated in "Appendix D" of the draft policy for impact areas specific to the region north of San Francisco Bay):

> "For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass bed resource, a ratio of 4.82 to 1 [transplant area to impact area] shall apply based on a 75 percent failure rate over the past 25 years [4 transplant actions]. That is, for each square meter of eelgrass bed adversely impacted, 4.82 square meters of comparable new eelgrass bed shall be planted in suitable conditions to support eelgrass mitigation. A total of 1.2 square meters of new eelgrass bed habitat shall be successfully established…for every square meter of eelgrass impacted."

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 in 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

Impacts to submerged aquatic vegetation such as eelgrass are typically assessed at the level of the action, such as disturbance related to a specific land use in an estuarine habitat. At that scale, impacts can be evaluated in terms of areal extent (square feet), which allows for appropriate regulatory decision-making in terms of avoiding or minimizing the impact, and finally mitigating for the impact (see discussion above under "Laws and Policies"). In assessing eelgrass impacts for this EIS, a determination of exact acreage cannot be quantified for alternatives B, C, and D because the impacts are systemic (i.e., related to activities that are occurring throughout Drakes Estero, not just at a single localized site) and would change from day to day over the course of the 10 year permit period. Approximate quantifications are provided in the impact analysis based on interpretation of aerial photography, which is consistent with other studies under similar conditions, as cited below. Finally, research conducted in Drakes Estero on eelgrass density, coverage, general ecological relationships, and/or impacts from shellfish operations, is limited to a few unpublished masters theses and observational data from NPS. To improve the impact analysis on eelgrass, information from primary literature sources (i.e., those that satisfy the criteria for "primary references" as described in Chapter 1: "References Used for Impact Analysis") was used, particularly published research in ecosystems with similar geographic and ecological setting as Drakes Estero. This was supplemented with the analysis and conclusions of the NAS review on eelgrass (NAS 2009). In addition, this included research in Drakes Estero conducted by Grosholz (2011b) documented the presence of nonnative invasive species tunicate *Didemnum* colonies growing on the distal portions of the leaf shoots of the eelgrass, and recent published literature from other ecosystems on tunicate colonization and dispersal (e.g., Herborg, O'Hara, and Therriault 2009; Carman and Grunden 2010, Simkanin et al. 2012; Morris and Carman 2012).

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 by VHB using GIS technology. The source for the aerial photographs used in this analysis was CDFG imagery taken in 2010 (CDFG 2010d). 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). Though the research presented in Zieman (1976) was conducted in Florida with different species of seagrasses, the aerial interpretation methodology developed is broadly applicable to seagrass research in a wide range of shallow estuarine habitats, such as Drakes Estero.

The total estimated linear distance of propeller scarring in Drakes Estero was estimated at 8.5 miles. Scars identified on the aerial images were digitized as lines in GIS, and the lengths of those lines were determined from the GIS shapefiles and then summed to produce an overall linear estimate. VHB's interpretation of propeller scarring on the 2010 aerial photographs (CDFG 2010d) 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). The width of the scars that were identifiable on the photographs varied from approximately 3 feet where a single track is visible (assumption based on the minimum width detectable at the scale and resolution of the aerial photographs) to 60 feet near the main channel in Schooner Bay; therefore, no uniform width was assigned to this estimate. Further, it was assumed that any scars visible at the scale of photography used in this analysis represented areas where eelgrass had been removed down to the level of the substrate (i.e., propeller damage that exposed the substrate so that it was visible on the photograph at 1:600 scale). The interpretation of propeller scarring on the 2010 aerial photographs (CDFG 2010d) was limited to areas that were clearly identifiable as scars; therefore, the 8.5-mile total is likely an underestimate. Scarring observed in algae, which appeared as brighter green zones on the photographs, was not included in the analysis (see figure 3-4).

Intensity Definitions

Negligible: The impact is not detectable or measurable.

Minor: Impacts on eelgrass would be slightly detectable and localized (affecting a small segment of the population in the project area), and would result in limited change to eelgrass meadows or natural processes (such as eelgrass colonization and/or regeneration).

Moderate: Impacts on eelgrass would be readily apparent and would affect eelgrass meadows or natural processes (such as eelgrass colonization and/or regeneration) in the project area.

Major: Impacts on eelgrass would be readily apparent, widespread, would substantially affect eelgrass meadows or natural processes (such as eelgrass colonization and/or regeneration) in the project area.

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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

In summarizing the effects of oyster cultivation 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 in 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 operations that result in direct damage to eelgrass habitat, particularly propeller scarring and shading effects from oyster racks (see discussion under alternative B). This would result in beneficial impacts on eelgrass, because 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). In addition, although direct measurements of effects on eelgrass from boat wake erosion and propeller-induced turbidity have not been made in Drakes Estero, literature on similar ecosystems (e.g., Thom et al. 2003) suggests that these phenomena could occur from boat operations. Under such conditions, alternative A would also result in beneficial impacts on eelgrass because eelgrass would no longer be subject to the potential for erosion created by DBOC-boat-generated waves; and (2) eelgrass would no longer be subject to the potential for temporary increases in turbidity caused by boat propellers disturbing and re-suspending bottom sediments. 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.

Removal of approximately 4,700 posts (2-inch by 6-inch boards) that support the shellfish racks would be expected to cause temporary increases in sedimentation (lasting 2 to 3 months). Standard BMPs such as silt curtains would be used to reduce turbidity effects from the temporary re-suspension of sediment during removal. Termination of DBOC activities would ultimately result in a beneficial impact on eelgrass because it would greatly reduce the potential for shellfish operation-related colonization and expansion of nonnative species such as colonial tunicates, which take advantage of the hard substrate created by the shellfish operations-related 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 shellfish cultivation structures to provide attachment sites for epiphytic macroalgae, which can compete with eelgrass for limiting resources such as sunlight (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 shaded by macroalgae, 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/shading, 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 in the 138 acres of growing areas would be removed, including the 5 linear miles (7 acres) of shellfish racks, as well as anchor lines and associated infrastructure used in floating culture. Removal would allow eelgrass to colonize substrates appropriate for eelgrass growth previously beneath shellfish operations-related structures (NAS 2009), resulting in short- and long-term beneficial impacts on eelgrass in these areas. New growth of eelgrass would provide additional natural habitat for the fish communities in 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. A detailed discussion of ecosystem benefits attributed to bivalves and bivalve cultivation is provided in "Chapter 3: Affected Environment". Based on west coast research (Dumbauld, Ruesink, and Rumrill 2009), these positive ecosystem effects would be expected to be relatively minor in smaller 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.

As described above, alternative A would result in long-term beneficial impacts on eelgrass due to the termination of DBOC operations in Drakes Estero, as well as the removal of structures that currently inhibit eelgrass abundance and serve as potential points of colonization and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic macroalgae, which is already occurring in proximity to DBOC structures in Drakes Estero. Alternative A also would result in short-term minor adverse impacts because removal of infrastructure associated with commercial shellfish operations would result in localized, slightly detectable increases in sedimentation that would last 2 to 3 months and would reduce the amount of sunlight available for eelgrass photosynthesis during those times, but would result in limited overall change to eelgrass meadows or natural processes. Alternative A would also result in long-term beneficial impacts as removal of racks would allow sunlight to penetrate the water column in areas that are currently shaded by racks. In addition, accumulated aquaculture shell and other debris underneath and adjacent to racks will be removed by hand to reduce hard substrate in the potential eelgrass bed areas.

Cumulative Impact Analysis

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

Planning and management activities may enable management activities such as administrative and research motorboat use in Drakes Estero. This would cause impacts on eelgrass similar to those discussed above caused by DBOC motorboats; however, boat use in 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 in Drakes Estero, providing indirect long-term beneficial impacts on eelgrass in 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 in Drakes Estero, the removal of scarring with discontinued use of motorboats in Drakes Estero, and the removal of structures that currently inhibit eelgrass abundance and serve as potential points of colonization and added substrate for the expansion of invasive species (e.g., tunicates) and macroalgae. There may be some highly localized adverse impacts on eelgrass associated with the 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 on eelgrass because removing infrastructure related to commercial shellfish operations would result in localized, slightly detectable increases in sedimentation that would last two to three months, reducing the amount of sunlight available for photosynthesis during that time. BMPs would be used to reduce turbidity effects from temporary resuspension of sediment during removal activities, and the overall impact would result in limited change to eelgrass meadows or natural processes. The cumulative impact would be long-term and 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 U.S. 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 in 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 motorized boat traffic

As described in chapter 3, extensive beds of eelgrass are present throughout Drakes Estero (Wechsler 2004[vi]; NAS 2009). DBOC activities, particularly continued 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 in 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, as noted by Fonseca and Bell (1998) in shallow embayments in North Carolina.

Due to NPS prohibitions on motorized vessels, pursuant to the Point Reyes Wilderness Act of 1976, motorized boats used in DBOC's commercial shellfish operations are 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 (CDFG 2010d) show that DBOC vessels transit through eelgrass, resulting in readily observable propeller damage across many areas of Drakes Estero.

In addition, DBOC operations adversely impact eelgrass cover and density because boats disturb the bottom substrate (Anima 1991[vii]), 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 two to five years, depending on the severity of the impact on the substrate or the root systems (Waddell 1964, as cited in Simenstad and Fresh 1995). 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 for pleasure craft and ferryboats on the west coast (Thom et al. 2003) and in the case of clam harvesting boats on the east coast (Thom et al. 2003; Peterson, Summerson, and Fegley 1987). Finally, boat traffic can cause temporary increases in water column turbidity due to resuspension of sediments, resulting in an increase in turbidity that can reduce the depth to which sunlight penetrates the water column. Since sunlight is a requirement for photosynthesis, and plants must photosynthesize to add biomass, boat-induced turbidity can result in temporary reductions in photosynthesis and can stall or reverse biomass accumulation (Crawford 2002). It is anticipated that regardless of the regrowth and recovery rates of eelgrass in Drakes Estero, the amount of scarring under alternative B would remain similar to that observed in the 2010 aerial photographs (i.e., while older scars may regrow, new scars would form as a result of ongoing operations).

Based on research conducted in Drakes Estero, structures 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[viii]; 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), although it should be noted that these studies describe various oyster culturing techniques and structures, not all of which are used by DBOC. Reduced coverage and density of eelgrass under or adjacent to shellfish operation-related structures 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 "Impacts on Wildlife and Wildlife Habitat: Fish" for additional detail on how this would affect fish species in Drakes Estero.

As documented in NAS (2009), the 7 acres (5 miles) of rack structures impede the ability of eelgrass to colonize and grow beneath the racks, resulting in direct impacts to eelgrass in these areas. DBOC has identified practices for growing purple-hinged rock scallop in Area 2 (1 acre), which currently has no infrastructure to support aquaculture activities. In their June 5, 2012 letter, DBOC stated that in order to grow purple-hinged rock scallops in Area 2, new floats and anchors would need to be added to this area to accommodate the new culture methods (DBOC 2012b[ix]). The impacts associated with new activities in Area 2 would be direct and ongoing.

As noted in NAS (2009), structures associated with commercial shellfish operations provide habitat documented to support invasive nonnative species such as *Didemnum*, and these structures provide stable habitat that may have supported the expansion of *Didemnum* to other areas and habitats of 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; Simkanin et al. 2012; Morris and Carman 2012), 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 (Carman and Grunden 2010).

In addition, bivalve cultivation structures provide potential attachment sites for epiphytic macroalgae (e.g., *Ulva* spp.). When this type of growth occurs adjacent to eelgrass, the macroalgae can compete with eelgrass for important resources such as light, thereby reduce the effective 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).

Shellfish operations 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 cultivation 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 through increased nutrient availability, which can, in turn, increase biomass and abundance (Newell and Koch 2004; NAS 2010). A more detailed discussion of the beneficial ecosystem effects of filter feeders is provided in chapter 3 under "Biogeochemical Cycling."

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 highly localized. Further, smaller west coast estuaries like Drakes Estero 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 such coastal systems (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).

Under alternative B, DBOC would repair or replace 50 inactive-dilapidated racks in 2013 and repair an additional 25 active racks in 2014. This would result in the installation of approximately 1,700 and 2,500 posts in Drakes Estero in 2013 and between 380 and 750 posts in 2014. The installation of these racks would result in localized, temporary disturbance of sediment during installation. During rack repair and/or replacement activities, there is potential for disturbance of sediment, physical damage to eelgrass plants, and disturbance of eelgrass habitat. Rack installation would require the use of BMPs, such as a silt curtain. Under alternative B, the impacts to eelgrass associated with rack repair and/or replacement, and the addition of floating culture infrastructure, would be expected to be short-term minor adverse because repair/replacement of shellfish structures would result in localized, slightly detectable increases in sedimentation, reducing the amount of sunlight available for photosynthesis during the activity.

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 readily apparent and would affect eelgrass meadows and natural processes (such as eelgrass colonization and regeneration) through the continuation of propeller scarring, disturbance of sediment, maintenance of structures that preempt space and shade out habitat, and potential for expansion of invasive species such as *Didemnum*.

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 colonization and added substrate for expansion of invasive species (e.g., tunicates) and macroalgae. In addition, propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), the potential for boat wake erosion, and the potential for 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 in areas where eelgrass is affected, 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 in 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 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 in Drakes Estero. DBOC activities in Drakes Estero under alternative B would allow the continuation of actions associated with commercial shellfish operations that could result in damage to eelgrass habitat, such as propeller scarring (estimated at 8.5 miles based on 2010 aerial photography), potential boat wake erosion, and potential temporary increases in turbidity from sediment resuspension given the area of boat operations in Drakes Estero. It is anticipated that the amount of scarring under alternative B would remain similar to that observed in the 2010 aerial photographs. Maintenance of offshore infrastructure would continue to preclude eelgrass colonization underneath the beds and approximately 7 acres of racks. Further, the continuation of DBOC activities and the presence of structures would increase the potential for colonization and expansion of nonnative species (e.g., colonial tunicates) and macroalgae, the latter of which can compete with seagrasses for important resources like light. These effects would have a long-term moderate adverse impact on eelgrass, which would be readily apparent and would affect eelgrass meadows and natural processes (such as eelgrass colonization and regeneration) through the continued effects of boat disturbance, shellfish infrastructure, and nonnative species. Rack repair and replacement would result in short-term minor adverse impacts on eelgrass because these activities would result in localized, slightly detectable increases in sedimentation, reducing the amount of sunlight available for photosynthesis. Mitigation for impacts to eelgrass would be required pursuant to California policy. Beneficial ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would continue. These beneficial impacts would be expected to be localized around shellfish operation sites. In general, impacts would be clearly detectable and could appreciably affect individuals or groups of species, communities, or natural processes. The NAS concluded that commercial shellfish operations in Drakes Estero result in impacts on eelgrass from the presence of racks and from boat propeller scars, but that 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, and adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to eelgrass, alternative B would 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 U.S. 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 in 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. DBOC would maintain and replace offshore racks, including 50 inactive racks in 2013 and 25 active racks in 2014. Further, since there are no purple-hinged rock scallops currently grown, new floats and anchors would need to be added to accommodate the culture of this species in Area 2. 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 described for alternative B.

Under alternative C, DBOC would be responsible for implementing harvest practices intended to minimize fragmentation and spread of *Didemnum* from oysters. This includes modification of current harvest and distribution practices to ensure that oyster strings or bags hosting *Didemnum* are managed in a way that does not distribute *Didemnum* to other areas of Drakes Estero. DBOC would be responsible for implementing practices as part of normal operations.

As described above, alternative C would result in long-term moderate adverse impacts on eelgrass in Drakes Estero for another 10 years. As with alternative B, impacts would be readily apparent and would affect eelgrass meadows and natural processes (such as eelgrass colonization and regeneration) as described above.

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 colonization and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic macroalgae, the latter of which can compete with eelgrass for light. In addition, propeller scarring (estimated 8.5 miles based on 2010 aerial photography), the potential boat wake erosion, and the potential 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 in areas where eelgrass is affected, 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 in 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 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 in Drakes Estero. DBOC activities in Drakes Estero under alternative C would allow the continuation of actions associated with commercial shellfish operations that could 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 given the area of boat operations in Drakes Estero. It is anticipated that because the level of boat use would remain similar to existing conditions, the amount of scarring under alternative C would remain similar to that observed in the 2010 aerial photographs. Maintenance of offshore infrastructure would continue to preclude eelgrass colonization underneath the beds and approximately 7 acres of racks. Further, the continuation of DBOC activities would increase the potential for colonization and expansion of nonnative species (e.g., colonial tunicates) and macroalgae, as described above. However, DBOC would be responsible for modifying current harvest and distribution practices to minimize potential for *Didemnum* to spread to other areas in the Estero through fragmentation. Rack repair and replacement would result in short-term minor adverse impacts on eelgrass because these activities would result in localized, slightly detectable increases in sedimentation, reducing the amount of sunlight available for photosynthesis. Beneficial ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would continue. These beneficial impacts would be expected to be localized around structures in Drakes Estero associated with commercial shellfish operations.

In general, impacts would be readily apparent and would affect eelgrass meadows or natural processes through the continued effects of boat disturbance, shellfish infrastructure, and nonnative species. The NAS concluded that shellfish operations in Drakes Estero result in impacts on eelgrass from the presence of racks and from boat propeller scars, but that 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 would be 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, and adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

With respect to eelgrass, alternative C would 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 U.S. 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 in 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 readily apparent and 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. As with alternatives B and C, DBOC would maintain and replace offshore racks, including 50 inactive racks in 2013 and 25 active racks in 2014. Further, since there are no purple-hinged rock scallops currently grown, new floats and anchors would need to be added to accommodate the culture of this species in Area 2. Impacts could appreciably affect eelgrass meadows or natural processes (such as eelgrass colonization and 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 colonization and added substrate for expansion of invasive species (e.g., tunicates) and epiphytic macroalgae, the latter of which can be detrimental to eelgrass due to shading. In addition, propeller scarring (estimated at 8.5 miles based on 2010 aerial photography) would cease, as well as the potential for boat wake erosion and temporary increases in turbidity from sediment resuspension. 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 in areas where eelgrass is impacted, 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 in 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 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 operations 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. Maintenance of offshore infrastructure would continue to preclude eelgrass colonization underneath the beds and racks. Further, the continuation of DBOC activities would increase the potential for colonization and expansion of nonnative species (e.g., colonial tunicates) and macroalgae, as described above. 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 readily apparent and would affect eelgrass meadows or natural processes (such as eelgrass colonization and regeneration). Rack repair and replacement would result in short-term minor adverse impacts on eelgrass because these activities would result in localized, slightly detectable increases in sedimentation, reducing the amount of sunlight available for

photosynthesis. Beneficial ecosystem effects typically attributed to bivalves, such as nutrient cycling and water clarity, would continue. These beneficial impacts would be expected to be localized around shellfish operation-related structures. The cumulative impact would be long-term, moderate, and adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to eelgrass, alternative D would 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 U.S. 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 states that "the National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems" (NPS 2006d, section 4.4 et seq.). 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 in 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.

NPS has a commitment to regional conservation planning. NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4 et seq.) also states, "in addition to maintaining all native plants and animal species and their habitats inside the parks, the Service will work with other land managers to encourage the conservation of the populations and habitats of these species outside parks wherever possible. To meet its commitments for maintaining native species in parks, the Service will cooperate with states, tribal governments, the U.S. Fish and Wildlife Service, NOAA fisheries, and other countries, as appropriate to…participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d).

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).

Invasive Species Executive Order 13112 directs federal agencies to: (1) prevent invasive species introductions; (2) detect, respond rapidly, control, and monitor invasive species where introduced; and also, (3) "provide for restoration of native species and habitat conditions in ecosystems that have been invaded." Executive Order 13112 also directs federal agencies to "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the U.S. or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

Finally, the California MLPA directs the reevaluation and redesign of California's system of MPAs to increase coherence and effectiveness in protecting the state's marine life and habitats, marine ecosystems, and marine natural heritage, as well as to improve recreational, educational, and study opportunities provided by marine ecosystems subject to minimal human disturbance. MPAs are located in and adjacent to Drakes Estero. Specifically, Point Reyes Headlands to the west of the project area and Estero de Limantour to the southeast have been designated as state marine reserves where the take of all living marine resources is prohibited. Drakes Estero is identified as a state marine conservation area where take of all living marine resources is prohibited, except for (1) recreational take of clams and (2) commercial aquaculture of shellfish pursuant to a valid state water bottom lease and permit. Due to the proximity of the proposed action to the MPAs, the MLPA was considered during preparation of this EIS. Section 124 of PL 111-88 does not relieve DBOC of its obligations to comply with the California MLPA.

METHODOLOGY

This section summarizes the impacts on benthic fauna from those actions that could potentially occur under each alternative. This impact analysis considers benthic organisms that are occurring naturally in Drakes Estero, as well as those that could be cultured under each alternative. The information used to evaluate impacts to native species, as well and nonnative species, is addressed below. In consideration of the different types of benthic organisms in 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).

Impacts to estuarine benthic fauna are often difficult to assess because benthic environments can have a diversity of species, each responding differently to potential changes in ecological conditions. Impact analysis of benthic habitat and organisms typically involves detailed sampling of the benthic community, followed by a model-based approach such as risk assessment. No such studies have been conducted in Drakes Estero to date. The research available on benthic fauna in Drakes Estero is limited to a few unpublished masters theses and independent research conducted by marine scientists (Grosholz 2011b). To improve the impact analysis on benthic fauna, information from primary literature sources (i.e., those that satisfy the criteria for "primary references" as described in Chapter 1: "References Used for Impact Analysis") was used, particularly published research in ecosystems with similar geographic and ecological setting as Drakes Estero. This was supplemented with the analysis and conclusions of the NAS review on benthic fauna (NAS 2009).

Intensity Definitions

Negligible: The impact is not detectable or measurable.

Minor: Impacts on benthic fauna would be slightly detectable and would only affect a small segment of the populations or their natural processes and/or habitat in the project area.

Moderate: Impacts on benthic fauna would result in readily apparent effects on populations, natural processes, or habitat in the project area.

Major: Impacts on benthic fauna would result in readily apparent and substantial effects on benthic fauna populations, natural processes, or habitat in the project area. Loss of habitat or consistent disruptions may affect the viability of the species in the project area.

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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The termination of DBOC activities in Drakes Estero would remove actions associated with shellfish operations that could otherwise cause the introduction of nonnative species, such as bivalves or molluscan diseases (see discussion under alternative B). This would have a long-term beneficial impact on native bivalves and the 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 use resources that would otherwise be available to native benthic species (NAS 2010). The native invertebrates of Drakes Estero are typically adapted to the 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). The removal of shellfish operations (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 cultivated shellfish (Friedman 1996; Burreson and Ford 2004). In addition, Pacific oysters and Manila clams have recently been documented to be naturalizing in Drakes Estero (Grosholz 2011b), and the removal of these nonnative cultivated species would reduce the risk of continued naturalization. The Pacific oyster has recently been identified as an invasive species in the San Francisco Bay region (San Francisco Bay Joint Venture Science Subcommittee 2011). Further, DBOC's use of diploid stock, as opposed to sterile triploid stock, in cultivating these species increases the risk of naturalization (NAS 2004) (see "Benthic Fauna" discussion, chapter 3).

As previously discussed in "Chapter 3: Affected Environment," the invasive tunicate *Didemnum* has become established in Drakes Estero on aquaculture structures, rocky outcrops, and as documented in Grosholz (2011b), on eelgrass. The removal of offshore commercial shellfish infrastructure would reduce the potential for new colonization of invasive tunicates, which, as the NAS reported, are associated with DBOC's structures (NAS 2009) (see discussion under alternative B). Invasive colonial tunicates have the potential to smother habitats and inhibit the normal biological functions of benthic fauna (Osman and Whitlatch 2007; Mercer, Whitlatch, and Osman 2009). In addition, structures associated with shellfish operations can support other nonnative and native fouling organisms (which attach to underwater structures during their adult phase, inhibiting the normal function of the structures). The removal of these structures would reduce the available substrate over which fouling organisms could attach and grow. Finally, the ability of invasive tunicates 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 may reduce the risk of further dispersing the tunicate. Reducing the structures supporting invasive tunicates would have a long-term beneficial effect on native benthic fauna diversity.

Studies in Drakes Estero (Harbin-Ireland 2004[x]; NAS 2009) and other systems (Castel et al. 1989; Nugues 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's offshore infrastructure would be expected to result in a slight increase in the abundance of certain species of native benthic invertebrates where the racks are currently located, mostly due to the expected regrowth of eelgrass in these areas. However, because structures associated with shellfish operations provide a different type of aquatic habitat compared with eelgrass beds, the species composition under these structures can be different.

To the extent that other benthic invertebrate species have colonized structures associated with shellfish operations, the habitat for these species would be removed. Regardless, the termination of bottom bag

culture in Drakes Estero would remove up to 88 acres of bags, potentially reopening habitat for native benthic fauna that would colonize the substrate 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 (Kaiser 2001) (see discussion under alternative B). Under alternative A, the termination of DBOC activities in Drakes Estero would remove the potential for such incidental 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 these activities cause direct destruction of native benthic fauna by boat propellers or indirect displacement by disruption of benthic sediments, the removal of such activities would result in beneficial impacts on benthic fauna. Termination of DBOC operations under alternative A would result in the 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. Removal of posts is expected to cause temporary localized disruption of benthic habitat when posts are removed, the effect of which would not be detectable in the benthic community.

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 in Drakes Estero would remove cultivated nonnative species from Drakes Estero, reduce risk for the spread of nonnative and invasive species in the future, reopen habitat for native benthic fauna, and eliminate the potential for substrate disturbance related to DBOC boat traffic. Though some sediment resuspension is anticipated during removal of racks, any sedimentation resulting from this activity would be short-lived and would be reduced to the extent practicable using BMPs.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact benthic fauna in the project area. These actions include coastal watershed restoration (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) and the CDFG MLPA initiative.

Recent coastal watershed restoration efforts in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) could improve water quality in 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 in 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 in Drakes Estero. Though recreational clamming has the potential to disrupt sediment and impact benthic fauna habitat on mudflats and sandbars, Drakes Estero is known to be used only occasionally for

this type of activity. Impacts related to recreational clamming are therefore expected to be localized and negligible. Other 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 actions, 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 shellfish operations in Drakes Estero would remove shellfish operations from Drakes Estero and, therefore, reduce the risk for the spread of nonnative and invasive species in the future. Alternative A would result in the removal of structures related to shellfish operations in Drakes Estero. Some sediment re-suspension would be anticipated during the removal of the 7 acres of racks; however, any sedimentation resulting from this activity would be short-lived and would be reduced to the extent practicable using BMPs, making the impact undetectable in the benthic community and therefore negligible. Although artificial habitat for certain benthic species would be removed when DBOC's offshore infrastructure is removed, alternative natural habitats (e.g., eelgrass beds) would be expected to replace these structures. Further, the removal of structures under alternative A would remove substrates that support invasive tunicates and other fouling species. Native benthic species would benefit from the removal of offshore infrastructure, particularly from the approximately 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). Native benthic species are adapted to the soft-bottom habitat and eelgrass that would likely replace the structures related to shellfish operations 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 nonnative species where these species interfere with natural processes and habitat (NPS 2006d). Alternative A would also be consistent with Executive Order 13112 regarding invasive species management. Finally, alternative A would be consistent with the California MLPA, regarding protection of marine life and habitats, marine ecosystems, and marine natural heritage, and improvements to recreational, educational, and study opportunities provided by marine ecosystems subject to minimal human disturbance.

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 in 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 and Manila clams
  - Permit Area 2: purple-hinged rock scallops

Based on graduate research conducted in Drakes Estero, the relative abundance of certain benthic invertebrates (i.e., the relative numbers of individuals in each species) was found to be lower directly underneath oyster racks than in nearby eelgrass habitat (Harbin-Ireland 2004[xi]; NAS 2009). Harbin-Ireland (2004[xii]) suggests that the decreased abundance in some species 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. This study 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 cultivation in Europe (Castel et al. 1989; Nugues et al. 1996), New Zealand (Christensen et al. 2003), and Canada (Lu and Grant 2008) have noted 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 decreases in oxygen availability, were implicated as causing reductions in benthic invertebrates. Other studies have found little effect of shellfish structures on benthic species, or even increases on species diversity and abundance, when compared with nearby natural habitats – particularly when those habitats are open mudflats or otherwise lack structure (see review in Dumbauld, Ruesink, and Rumrill 2009; also DeGrave, Moore, and Burnell 1998; Mallet, Carver, and Landry 2006). Though Harbin-Ireland (2004[xiii]) 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.

Under alternative B, a maximum of 84 acres of bottom bags would be placed in Drakes Estero at any given time. The actual acreage occupied by bottom bags varies year to year. According to DBOC proof-of-use reports, 22 acres of bags were planted in both 2009 and 2010. In addition, strings from rack culture are placed on these growing areas to harden shells for 3 to 9 months prior to harvest. 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 in 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 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 2006*, 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 incidental mortality can cause a loss of native benthic invertebrates (Kaiser 2001; Kaiser et al. 1998).

The Pacific oyster, which is the primary species cultivated by DBOC, is not native to the Northern California region (Ruesink et al. 2005). Similarly, the Manila clam, a recent introduction into DBOC's shellfish cultivation stock, is a nonnative species. Such introductions have the potential to develop naturally breeding populations in Drakes Estero (NAS 2004, 2009). For example, the Pacific oyster has been observed growing independent of culture stock in Tomales Bay and Drakes Estero In addition, the Manila clam has been observed growing independent of culture stock in Drakes Estero (Grosholz 2011b). The introduction of commercially grown nonnative bivalve species carries a certain level of risk (Padilla 2010). Nonnative species would reduce native bivalve access to 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 been observed for the Manila clam (e.g., Pranovi et al. [2006] in Italy), the native Olympia oyster (Trimble, Ruesink, and Dumbauld 2009), and other species introductions on the west coast (Ruesink et al. 2005). Based on extensive research in other areas (such as the mid-Atlantic region of the U.S.), use of sterile, triploid stock would reduce the potential for naturalizing populations of cultured species (for a review, see NAS 2004).

A production level of 600,000 pounds per year under alternative B would result in the continued addition and subsequent extraction of approximately 7.06 million individuals of nonnative shellfish in Drakes Estero (assuming all shellfish produced are Pacific oysters at a conversion rate of 100 oysters per gallon and 8.5 gallons per pound). This level of production would sustain the current risk for naturalization of cultured nonnative species into Drakes Estero (NAS 2004).

While bivalve cultivation 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 smaller 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; Burreson and Ford 2004), as well as herpes viral infections (Friedman et al. 2005; Burge et al. 2005). In general, introduced shellfish diseases pose a threat to native populations of bivalves (NAS 2004; Burge, Griffin, and Freidman 2006; NAS 2010), although MSX only affects Pacific and eastern oysters. 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. CDFG also regulates DBOC's operation with respect to the stocking of aquatic organisms, brood stock acquisition, disease control, importation of aquatic organisms into the state, and the transfer of organisms between waterbodies, which minimizes potential threats related to disease.

Under alternative B, the species cultivated by DBOC would remain generally the same, with the Pacific oyster continuing and the Manila clam allowed under this permit process representing the principal species stocked. However, DBOC would also 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). Cultured purple-hinged rock scallops typically require a hard artificial substrate for grow-out (Culver, Richards, and Page 2006). Based on correspondence from DBOC, floating culture would be used to grow scallops (DBOC 2012c[xiv]), which would require new float and anchors in Permit Area 2. Floating culture would continue to be stabilized with 100-pound concrete anchors attached with ropes (DBOC 2012b[xv]). 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[xvi]; Press 2005), adult purple-hinged rock scallops are not likely to be found naturally growing in abundance in 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.

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; Morris and Carman 2012). Regular DBOC operations, such as turning bags over or relocating strings of rack oyster for hardening on sandbars, have the potential to cause fragmentation of *Didemnum* when present. 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 operation-related structures represent a point of colonization for invasive tunicates on the west coast (Herborg, O'Hara, and Therriault 2009), these invaders are likely to remain a problematic species.

In addition, Byers (1999) studied the invasion of a nonnative mud snail (*Batillaria attramentaria*), making specific reference to JOC. This organism was found to be detrimental to native snail populations, a point that was also noted in the recent NAS study of commercial shellfish operation effects in Drakes Estero (NAS 2009).

In a letter dated November 15, 2010, DBOC indicated that it manages invasive species by meeting the requirements set forth by its CDFG lease and Title 14 CCR to "minimize the chances of introducing invasive species or pathological microorganisms to Drakes Estero" (DBOC 2010s). Under this alternative, DBOC may replace the existing oyster wash system with a sediment basin that may also capture fragments of tunicates from reentering the bay from the onshore processing area.

Under alternative B, DBOC would repair or replace 50 inactive-dilapidated racks in 2013 and repair an additional 25 active racks in 2014. This would result in the installation of between 1,700 and 2,500 posts in Drakes Estero in 2013 and between 380 and 750 posts in 2014. The replacement of these racks would result in localized, temporary disturbance of sediment. During rack repair and/or replacement activities, there is potential for disturbance of sediment and benthic habitat. Rack replacement would require the use of BMPs. The impacts to benthic fauna associated with rack repair and/or replacement under alternative B would, therefore, be expected to be short-term and negligible.

As described under "Impacts on Wildlife and Wildlife Habitat: Fish" below, the posts and other treated wood associated with offshore infrastructure could adversely impact water quality, resulting from the release of copper leachates from pressure treated lumber. Metals leached into the environment from treated lumber are known to accumulate in the tissues of benthic organisms (Weis, Weis, and Proctor 1998). Existing posts do not pose a risk of copper leachate release due to the extended length of time in contact with water. Further, based on regulatory permit conditions that would likely be associated with rack repair activity, this assessment assumes that any new lumber used for rack repair would require an approved coating material in order to minimize the potential for release of copper leachates from treated wood into aquatic environments. Therefore, impacts from pressure treated wood on benthic fauna would be negligible.

Finally, under alternative B the potential for substrate disturbance related to continued DBOC boat traffic in the main channel of Schooner Bay would continue (Anima 1991[xvii]). 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.

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 in Drakes Estero would have the potential to introduce nonnative species and/or diseases, facilitate colonization and expansion of invasive tunicates, and cause physical disturbance to native benthic fauna and their habitat. These impacts would be readily apparent and would affect populations, natural processes, and/or benthic habitat in the project area.

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 incidental mortality. In addition, removal of offshore infrastructure would reduce the potential for *Didemnum* colonization, and removal of associated shellfish operations (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 in Drakes Estero under alternative B may allow these shellfish species to become further established in the Drakes Estero benthic community. For instance, the 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 nonnative and 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 in 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 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 for an additional 10 years due to the continuation of DBOC operations and associated human activities in Drakes Estero, as well as the potential for such activities to introduce and/or facilitate the colonization of nonnative and invasive species. Specifically, the cultivation of nonnative species in Drakes Estero for an additional 10 years at production levels of 600,000 pounds of shellfish annually would result in the continued addition and subsequent harvest of approximately 7.06 million individual shellfish from Drakes Estero on an annual basis. Based on DBOC proof-of-use reports, the acreage of sandbars and mudflats occupied at this level of production would be 50 percent greater than that reported for 2008 in the 2009 NAS report. The effects on the natural benthic community from this would be readily apparent, including the continued use by nonnative species of resources that would otherwise be available to native species of bivalves and other benthic organisms, the introduction of molluscan diseases, and other harmful nonnative species being imported unintentionally (such as the invasive tunicate *Didemnum*). The use of both bottom bags and racks has been implicated in detectable changes in benthic communities. The continued maintenance and use of DBOC offshore infrastructure would result in a slight decrease in the abundance of certain benthic invertebrate species where the racks are currently located, while the continuation of bag cultivation in Drakes Estero would maintain artificial structured habitat for some benthic invertebrates. Rack repair and replacement would result in short-term negligible adverse impacts to benthic fauna, because the effects from these activities would not be detectable or measurable. Activities such as continued maintenance and harvesting would allow for incidental 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 shellfish operations (such as continued 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 coverage of *Didemnum* would have an adverse impact on species diversity. Lastly, the nonnative Manila clam and Pacific oyster would continue to be produced under this alternative, increasing their chance for naturalization (NAS 2004, 2009; Grosholz 2011b). DBOC's use of diploid stock rather than sterile triploid stock further increases the risk of

naturalization by cultivated species (NAS 2004). These impacts would be readily apparent on the populations, natural processes, and/or habitat of benthic organisms in the project area. The cumulative impact would be long term, moderate, and adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

The continued introduction and maintenance of nonnative species in Drakes Estero would not be consistent with NPS *Management Policies 2006* in that it would not further the goal of policies, which, in this case, would be to minimize the impacts of human activities on native benthic fauna populations. The shellfish species that could be cultivated under this alternative are nonnative, with the exception of the purple-hinged rock scallop, which is native to the rocky California coast but is not likely to be found in abundance in Drakes Estero due to the low availability of hard substrate for attachment. Further, alternative B would not be consistent with Executive Order 13112 regarding invasive species management.

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 in 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 (897 acres): Pacific oysters
  - Permit Area 2 (1 acre): purple-hinged rock scallops

Under alternative C, the offshore SUP would include 896 acres, 138 acres of which would be occupied by culture beds associated with the production of Pacific oysters and purple-hinged rock scallops. Pacific oysters would be cultivated in beds in the 896-acre Area 1, while purple-hinged rock scallop cultivation would be limited to the 1-acre Area 2. Manila clams would be removed from all growing areas under alternative C, minimizing the potential for this nonnative species to become established in Drakes Estero and use resources that would otherwise be available to native bivalves and other benthic fauna. The potential risk of nonnative bivalves establishing breeding populations in 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, assuming all shellfish produced are Pacific oysters at a conversion rate of 100 oysters per gallon and 8.5 gallons per pound).

Under alternative C, DBOC would be responsible for implementing harvest practices intended to minimize fragmentation and spread of *Didemnum* from oysters. This includes modification of current harvest and distribution practices to ensure that oyster strings or bags hosting *Didemnum* are managed in a way that does not distribute *Didemnum* to other areas of Drakes Estero. DBOC would be responsible for implementing practices as part of normal operations.

As described above, alternative C would result in long-term moderate adverse impacts on benthic fauna for another 10 years because of the continuation of DBOC operations and associated human activities in Drakes Estero during this period, which could introduce nonnative species and/or diseases, facilitate colonization and expansion of invasive tunicates, and cause physical disturbance to native benthic fauna and their habitat. These impacts would be readily apparent and would affect populations, natural processes, and/or benthic habitat in the project area.

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 in 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 do not occur in abundance as adults in Drakes Estero). Prolonging the presence of these species under alternative C could hinder NPS efforts at nonnative and 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 in 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 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 in Drakes Estero and the potential for such activities to introduce nonnative species and to facilitate the colonization and expansion of invasive species. Although Manila clams would no longer be cultivated under this alternative, the cultivation of Pacific oyster in Drakes Estero would have readily apparent effects on the communities of natural benthic organisms, including increasing the risk of introduction of molluscan diseases and expansion of other nonnative species (such as the invasive tunicate *Didemnum*). As discussed under alternative B, DBOC's use of diploid stock rather than sterile triploid stock increases the risk of naturalization by cultivated species (NAS 2004), although the potential risk under alternative C would be incrementally less than under alternative B. DBOC would be responsible for modifying current harvest and distribution practices to minimize potential for *Didemnum* to spread to other areas in Drakes Estero through fragmentation. The use of both bottom bags and racks has contributed to detectable changes in benthic

communities. Because shellfish production limits would be less under alternative C compared to alternatives B and D, the level of impact on benthic fauna would be incrementally less; however, the impacts would still be readily apparent and would affect benthic populations, natural processes, and/or habitat in the project area. Activities related to rack repair and/or replacement would be temporary in nature and subject to BMP requirements; therefore, impacts on benthic fauna from rack repair and/or replacement would be negligible (i.e., not detectable or measurable). Cumulative impacts would be long term, moderate, and adverse, and alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

The continued introduction and maintenance of nonnative species in Drakes Estero would not be consistent with NPS *Management Policies 2006* in that it would not further the goal of the policies, which, in this case, would be 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 not likely to be found in abundance in Drakes Estero due to the low availability of hard substrate for attachment. Further, alternative C would not be consistent with Executive Order 13112 regarding invasive species management.

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 in 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
- Cultivation of Pacific oysters, Olympia oysters, Manila clams, and purple-hinged rock scallops

Under alternative D, the range of species cultivated by DBOC would be expanded to include the Olympia oyster (in addition to the Pacific oyster, Manila clam, and the purple-hinged rock scallop)increasing the diversity of species, as well as increasing the offshore SUP to 1,082 acres. 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 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 in Drakes Estero. Inspections 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 Praetzellis 2011; Babalis 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, the adult form is not likely to occur naturally in large numbers in Drakes Estero due to the low incidence of naturally-occurring hard substrates for attachment sites. 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.). More detail on collection methods is needed to determine whether this type of activity would be authorized. Any individuals brought in from outside sources would be subject to CDFG regulations.

Under alternative D, shellfish production levels would be increased to 850,000 pounds (estimated at 10 million individuals harvested annually, assuming all shellfish produced are oysters at a conversion rate of 100 oysters per gallon and 8.5 gallons per pound). This is a substantial increase from alternative C (500,000 pounds) and alternative B (600,000 pounds). As such, alternative D would result in a greater adverse impact on benthic fauna than alternatives B and C.

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 than under current conditions or alternatives B or C. As described above, alternative D would result in long-term moderate adverse impacts on benthic fauna for another 10 years because DBOC operations and associated human activities in Drakes Estero would continue for this period. This would increase the potential for shellfish operations to introduce nonnative species and/or diseases, facilitate colonization and expansion of invasive tunicates, and cause physical disturbance to native benthic fauna and their habitat. These impacts would be readily apparent and would affect populations, natural processes, and/or benthic habitat in the project area.

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 in Drakes Estero under alternative D may allow these nonnative species to become further established in the Drakes Estero benthic community. Prolonging the presence of these species under alternative D could hinder NPS efforts at ecosystem management in Drakes Estero and could lengthen the period of time required before a natural benthic faunal community could be re-established, compared to alternative A.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact benthic fauna in 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 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 in Drakes Estero. This would increase the potential for shellfish operations to introduce nonnative species to Drakes Estero and facilitate the colonization and expansion of 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 in Drakes Estero would be readily apparent and would affect populations, natural processes, and/or the habitat of natural benthic organisms, including increasing the risk of introduction of molluscan diseases and expansion of other nonnative species (such as the invasive tunicate *Didemnum*). While certain species introduced under alternative D are native to the region (i.e., purple-hinged rock scallops and Olympia oysters), they are not abundant in Drakes Estero in adult form. The use of both bottom bags and racks has contributed to detectable changes in benthic communities. These impacts would continue to be readily apparent, affecting benthic populations, natural processes, and/or habitat in the project area. Activities related to rack repair and/or replacement would be temporary in nature and subject to BMP requirements; therefore, impacts on benthic fauna from rack repair and/or replacement would be negligible. Cumulative impacts would be long term, moderate, and adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

The continued introduction and maintenance of nonnative species in Drakes Estero would not be consistent with NPS *Management Policies 2006* in that it would not further the goal of these policies, which, in this case, would be to minimize the impacts of human activities on native benthic fauna populations. The 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 not likely to be found in abundance in Drakes Estero, and the Olympia oyster, which also prefers a hard substrate and is not abundant in adult form in Drakes Estero. Additionally, DBOC's proposal to collect native shellfish larvae in Drakes Estero would not be consistent with the NPS mission, per *Management Policies 2006* (NPS 2006d) or regulations. Further, alternative D would not be consistent with Executive Order 13112 regarding invasive species management.

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 in 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).

In addition, 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. The analysis presented is based in part on Wechsler's 2004 report of fish and fish habitat, which is the only fish study available pertaining specifically to Drakes Estero. As a result, regional and national sources were also investigated and used in portions of the analysis where components of the aquatic environment were similar and applicable. Abundant studies have been conducted on seagrass landscapes and their associated fauna, and literature was available which reviewed trends, data gaps, and need for future research.

Wechsler sampled the fish community in Drakes Estero seasonally from December 2002 to January 2004. The intent of the study was to compare the fish assemblage in portions of Schooner Bay that had active oyster mariculture operations, to the fish assemblage of Estero de Limantour where oyster mariculture is absent. The fish in the subtidal portions of Schooner Bay were sampled adjacent to three randomly selected shellfish racks in and then at a distance of approximately 250 feet away from the same three racks. Fish in Estero de Limantour were sampled from an additional three randomly selected sites. The oyster racks in Schooner Bay were located in heavily vegetated eelgrass beds.

In an attempt to catch representative sample of all types of fish, sampling was conducted using a variety of nets, including trawls, gill nets, and minnow traps. Wechsler caught 3,128 fish in total, but due to difficulties during two sampling efforts, some data was not included in the study. As a result, the data used for the study reflected the 2,816 fish caught from successful sampling efforts, representing 29 species of fish. Forty-four percent of all fish were captured in Estero de Limantour, 36 percent of fish were captured at stations away from shellfish racks, and 26 percent of fish were captured at stations adjacent to the shellfish racks.

Since the Wechsler study is the only study of its kind conducted in Drakes Estero, the analysis in this section is supplemented by information from studies from other U.S. Pacific Coast estuaries and coastal lagoons. This additional level of analysis is intended to help establish a baseline of fish and fish habitat information that is relevant to the fish community in Drakes Estero. Data available from other U.S. Pacific Coast estuarine fish studies is relatively abundant and represents a variety of estuarine habitats. Several studies

used for the analysis were conducted in Humboldt Bay, California, which is larger in area than Drakes Estero, but has comparable eelgrass habitat and mariculture components to those of Drakes Estero.

In order to analyze the relationship between fish and fish habitat (such as eelgrass) in Drakes Estero, information was used from literature that presented broader overviews of estuarine landscapes with seagrass habitats. The information is useful to understand the ecology of seagrass habitat as it pertains to fish communities. Fish and fish habitat analysis is also supplemented by information presented in current fishery management plans produced by the PFMC. The plans are useful to understand characteristics related to essential fish habitat, as well as the fish species for which this habitat is designed to manage.

In consideration of the different types of fish species in 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

Negligible: The impact is not detectable or measurable.
Minor: Impacts on fish would be slightly detectable and would only affect a small segment of the population or their natural processes and/or habitat in the project area.
Moderate: Impacts on fish would result in readily apparent effects on populations, natural processes, or habitat in the project area.
Major: Impacts on fish would result in readily apparent and substantial effects on fish populations, natural processes, or habitat in the project area. Loss of habitat or consistent disruptions may affect the viability of the species or cause populations to relocate outside the project area.

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.

As described in the “Impacts on Eelgrass” section of this chapter, alternative A would eliminate impacts on eelgrass habitat from commercial shellfish operations. This would allow eelgrass habitat to expand into areas previously lacking and could result in a beneficial impact on some fish species included the Groundfish Plan. Three of the 29 species (approximately 10 percent) identified in a study assessing the relationship between fish species present and shellfish operations in Drakes Estero (Wechsler 2004[xix]), were listed in the Groundfish Plan (PFMC 2005), including leopard shark (*Triakis semifasciata*), starry flounder (*Platichthys stellatus*), and cabezon (*Scorpaenichthys marmoratus*). Based on the habitat descriptions in the Groundfish Plan (PFMC 2008), eelgrass is only one type of habitat used by these 3 species. Therefore, in the absence of

additional site-specific data, it is unclear to what degree these species may rely on eelgrass in Drakes Estero as an essential habitat element.

Studies of fish assemblages conducted in multiple central California coast estuaries (Monaco, Lowery, and Emmett 1992) indicate a greater diversity of Groundfish Plan species than that shown by Wechsler in 2004. For instance, brown rockfish (*Sebastes auriculatus*), bacaccio (*Sebastes paucispinis*), blue rockfish (*Sebastes mystinus*), and grass rockfish (*Sebastes rastrelliger*) are species managed under the Groundfish Plan that are strongly associated with central California coast estuaries (Monaco, Lowery, and Emmett 1992) but not included in Wechsler's (2004) report. Both juveniles and adults of these species can be associated with seagrasses in estuarine zones, including eelgrass habitat (PFMC 2005). Therefore, an expansion of eelgrass habitat could have beneficial impacts on some groundfish species and essential fish habitat included in the Groundfish Plan.

Areas of designated essential fish habitat pertaining to the Coastal Pelagic Species Fishery Management Plan also extend to the California shoreline and include Drakes Estero. The lateral boundary of essential fish habitat for species evaluated in this plan includes estuarine and marine surface waters from the shoreline of Drakes Estero extending 200 nautical miles offshore, where sea surface temperatures range between 10 degrees C to 26 degrees C (PFMC 1998). This area of essential fish habitat reflects the typical habitat requirements of these coastal pelagic species, which can be largely dependent on water temperature. For instance, the subpopulation of northern anchovy near Drakes Estero is typically found in waters ranging from 12 degrees C to 21.5 degrees C (PFMC 1998).

Of the five species included in the Coastal Pelagic Species Fishery Management Plan, the Pacific sardine and northern anchovy are more likely to be found in Drakes Estero than others. Like the northern anchovy, Pacific sardine habitat is limited by a range in water temperature. However, while sardines can be found in estuaries, they usually undergo all life stages in near shore and offshore environments (PFMC 1998). Northern anchovies can be abundant in estuaries and have been found in Drakes Estero (Wechsler 2004[xviii]), but were observed in very low quantity relative to large schools of anchovies found in the greater subpopulation. With the limited information available about the use of Drakes Estero by these coastal pelagic fish species, it is unclear to what degree alternative A would provide benefits to the species and essential fish habitat included in the Coastal Pelagic Fishery Management Plan.

Additional essential fish habitat found in Drakes Estero is included in the Pacific Coast Salmon Fishery Management Plan. The effects of this alternative on federally listed salmon and/or their critical habitat in Drakes Estero are described in this chapter in the "Impacts on Special-Status Species" section.

The other fish species observed in the Wechsler (2004[xix]) study, described above, are not listed in fishery management plans maintained by the Pacific Fishery Management Council. As such, Drakes Estero is not designated as essential fish habitat for these species. Five of these species (topsmelt [*Atherinopsis affinis*], three-spined stickleback [*Gasterosteus aculeatus*], staghorn sculpin [*Leptocottus armatus*], bay pipefish [*Syngnathus leptorhynchus*], and kelp surfperch [*Brachyistius frenatus*]) were the most prevalent species captured in the study, comprising approximately 89 percent of the total catch (Wechsler 2004[xx]).

Wechsler (2004)[xxi] noted that DBOC's offshore infrastructure had little effect on fish species abundance or community composition when compared with the other habitats that were sampled. The only trend noted was an increase in kelp surfperch, a structure-oriented fish typically associated with hard substrates such as oyster

racks (Wechsler 2004[xxii]) (see discussion under alternative B). The idea that the structure from oyster racks provides habitat for certain fish is supported elsewhere in the literature (e.g., Pinnix et al. 2005; NAS 2009).

As stated in the ”Impacts on Benthic Fauna” section above, Drakes Estero is naturally a soft-bottomed estuary with little natural hard 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’s offshore structures attracts prey of native structure-oriented fish species, such as amphipods and other small crustaceans. Therefore, the removal of DBOC’s shellfish operation 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.

Under this alternative, an increase in eelgrass habitat as a result of the removal of motorboats and oyster racks from Drakes Estero (as described in the “Impacts on Eelgrass” section of this chapter) could affect fish in Drakes Estero. Fragmentation in seagrass habitat, like that caused by motorboat propeller scars and oyster racks in Drakes Estero, has been shown to have different, and sometimes contradictory effects on fish communities (Bostrom, Jackson, and Simenstad 2006; Bostrom et al. 2011). For instance, a study comparing fish captured at the edge of propeller scars to those approximately 33 feet in adjacent seagrass beds showed a greater abundance of fish in the seagrass samples (Uhrin and Holmquest 2003). However, the same study also showed that fish abundance was the same when observed in the middle of propeller scars and at approximately 16 feet in seagrass habitat (Uhrin and Holmquest 2003). Studies on this type of spatial redistribution of fish in Drakes Estero have not been performed; however, it is likely that a spatial redistribution of fish in areas surrounding fragmented eelgrass habitat could occur. Therefore, the recolonization of eelgrass habitat after the removal of shellfish operations could lead to a subsequent restoration of the natural distribution of fish in Drakes Estero.

Changes to water quality as a result of removal of DBOC’s offshore structures that could affect fish in Drakes Estero are not anticipated under alternative A. The structures are made from pressure treated wood and the two common wood preservatives used in the region (ammoniacal copper zinc arsenate and chromate copper arsenate) have the ability to leach copper into the aquatic environment. However, the majority of leaching from wood treated with ammoniacal copper zinc arsenate in saline waters occurs in the first 10 days (Brooks 1995, NOAA 2009) after contact, and leaching of copper from wood treated with chromate copper arsenate occurs in the first 90 days (Sanger and Holland 2002). As a result, the wooden structures used for oyster racks in Drakes Estero have been in contact with water for years and are not expected to continue the release of wood preservative leachates into the aquatic environment. Therefore, removal of wooden offshore structures is not anticipated to release copper leachate that would affect water quality and negatively affect fish or fish habitat.

Offshore structures are subject to deterioration and damage by weather events which may result in dispersal of items such as Styrofoam floats, treated lumber displaced from racks, and PVC piping and separators. Marine debris from damaged mariculture infrastructure has become dislodged and found floating in Drakes Estero or washed up on mudflats and shorelines. Under this alternative, all racks and bags would be removed, and the fish community in Drakes Estero would benefit as the potential for mariculture debris pollution to enter the aquatic environment and affect fish would be eliminated.

The removal of offshore structures associated with the oyster racks in Drakes Estero would result in temporary localized increases in turbidity for the 2 to 3 months it would take to remove them. This would

cause highly localized and temporary disruptions to fish in the vicinity of the removal. Fish would be expected to temporarily relocate to other areas of Drakes Estero during such disruption. Further, standard sediment control BMPs would be implemented to reduce sediment erosion into neighboring wetlands or other waters. The impacts to fish and fish habitat associated with removal of rack structures under alternative A would therefore be expected to be short-term and minor.

In the long-term, the removal of motorboats and oyster racks would likely result in regrowth of eelgrass in areas currently impacted by approximately 8.5 miles of propeller scars and 7 acres of oyster racks. 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 and resulting in a localized shift in fish species composition. While the natural spatial distribution of fish in Drakes Estero would be restored under this alternative, the removal of shellfish operation infrastructure would reduce the availability of prey for structure-oriented fish species and result in localized decreases in the abundance of these types of fish species. This would allow the Drakes Estero ecosystem to return to a more natural state, with a reduced exposure to marine debris. Therefore, alternative A would result in long-term beneficial impacts due to the restoration of natural fish habitat.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact fish in 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 in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) have created or enhanced fish passage in five streams in the Drakes Estero watershed. All five streams support the federally listed steelhead and have the potential to support federally listed coho salmon. These efforts could also enhance eelgrass habitat in Drakes Estero due to improved watershed conditions. As such, watershed restoration efforts in the Drakes Estero watershed could result in long-term beneficial impacts on fish. The MLPA prohibits the take of any living marine resource in 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 in Drakes Estero. Fishing, either recreationally or commercially, is prohibited under the act; therefore, the MLPA would have a noticeable 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, including the restoration of natural eelgrass beds that serve as essential fish habitat for a variety of Pacific groundfish identified in the Groundfish Plan (PFMC 2008). Alternative A would result in a more natural species composition and spatial distribution of fish in the project area, which would likely result in minor adverse impacts on fish due to slightly detectable decreases in the abundance of structure-oriented fish species and their prey. Alternative A would also result in short-term minor adverse impacts on fish species because the disruption of fish during rack removal from Drakes Estero would be slightly detectable and would affect only a small portion of the population and/or habitat in the project area. Combined with the removal of a source of marine debris, changes resulting from this alternative would return the Drakes Estero ecosystem to a more natural state for the overall fish community. The cumulative impact for alternative A would be beneficial and 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 the 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 in the Pacific Fishery Management Council's Groundfish 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 in 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 motorized boat traffic

The impacts on fish associated with alternative B are, in part, related to impacts on eelgrass, which is the primary natural fish habitat in Drakes Estero. Impacts related to eelgrass are detailed in the "Impacts on Eelgrass" section of this chapter. Ninety-five wooden shellfish cultivation racks, totaling approximately 5 miles (7 acres) in Drakes Estero, displace natural eelgrass habitat. Motorboat propeller scars have damaged or displaced approximately 8.5 miles natural eelgrass habitat.

The displacement of natural eelgrass habitat caused by racks associated with DBOC shellfish operations provides non-natural habitat that attracts preferred prey species for structure-oriented fish. In a study of shellfish operations on fish populations in Drakes Estero, Wechsler (2004[xxiii]) noted an increase in structure-oriented fish, such as kelp surfperch (*Brachyistius frenatus*). Of the 341 kelp surfperch captured during the Wechsler (2004[xxiv]) study, only 41 individuals (approximately 12 percent of the total catch) were collected in Estero de Limantour, which is absent of shellfish operations structures. Of the 300 kelp surfperch

captured in Drakes Estero, 195 (approximately 57 percent of the total catch) were found near oyster racks in Schooner Bay and 105 (approximately 31 percent of the total catch) were found away from oyster racks (Wechsler 2004[xix]). Wechsler (2004[xxv]) indicated that no significant statistical differences were observed in the abundance of all fish sampled, the number of species captured, or number of species among sites; however, the data pertaining to structure-oriented fish was not verified by a separate statistical analysis.

The study indicated the compositional differences of the fish communities using 5 similarity tests, where 4 of the 5 similarity tests showed that the fish community sampled near oyster racks was the most compositionally different from the fish community sampled in Estero de Limantour (Wechsler 2004[xxvi]). Based on the data provided on the abundance of kelp surfperch among sites, it is likely that the results of the similarity tests described above are supported by the greater number of structure-oriented fish observed near oyster racks (Wechsler 2004[xxvii]). The idea that oyster racks provides habitat for certain fish is also supported elsewhere in the literature (e.g., Pinnix et al. 2005; NAS 2009). Under alternative B, the continued presence of DBOC's offshore infrastructure 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.). Since Drakes Estero is naturally a soft-bottomed estuary with little structure, these types of structure-oriented species would normally be expected in less abundance due to a lack of suitable habitat.

The impacts to eelgrass habitat in Drakes Estero (See the "Impacts to Eelgrass" section in this chapter) could also alter the fish community as a result of habitat fragmentation. Eelgrass habitat is fragmented underneath oyster racks and in motorboat propeller scars where eelgrass is displaced or damaged. These non-natural habitat gaps can alter fish distribution in the gap itself, or over a broader area in the surrounding eelgrass; however, the response of fish to this type of fragmentation is varied and can be species-specific (Bostrom, Jackson, and Simenstad 2006, Bostrom et al. 2011). Some studies of fish in seagrass habitat damaged from single propeller scars, like those caused by DBOC boats, show that non-natural habitat gaps can create a divergence in abundance between the fish community along gap edges and in nearby seagrass beds (Uhrin and Holmquest 2003). However, due to differences in factors such as size and dispersal ability, not all fish species are affected by the non-natural habitat in the same way (Bostrom, Jackson, and Simenstad 2006) and some may be unaffected (Uhrin and Holmquest 2003). Nevertheless, based on the fish species diversity and substantial nursery function of Drakes Estero (Wechlser 2004[xxviii]), and the extent of damage or displacement to eelgrass habitat anticipated under this alternative, literature supports the idea that the habitat fragmentation caused by DBOC motorboats and oyster racks has the potential to create a non-natural spatial redistribution of fish that could locally influence the functionality of the fish habitat.

The displacement of natural eelgrass habitat by DBOC shellfish cultivation racks also has potential impacts to essential fish habitat. As stated in above, eelgrass is designated as essential fish habitat under the Groundfish Plan (PFMC 2008). While some insight regarding local groundfish use in Schooner Bay is presented by Wechsler (2004[xxix]), it is unclear to what degree the particular species captured in the study may rely on eelgrass beds in Drakes Estero as an essential habitat element. As described under alternative A, studies of fish assemblages conducted in multiple central California coast estuaries (Monaco, Lowery, and Emmett 1992) indicate a greater diversity of Groundfish Plan species than that shown by data collected by Wechsler in Drakes Estero. Therefore, based on available and relevant data, alternative B has the potential to adversely impact some Groundfish Plan species due to the displacement of eelgrass, which is designated as essential fish habitat.

Additionally, should a new SUP be issued, potential impacts to fish could occur as a result of repair and replacement of oyster racks. Under alternative B, DBOC would repair 50 inactive-dilapidated racks in 2013 and another 25 active racks in 2014 (DBOC 2012b [xxx]). Some of the infrastructure on the existing racks that need repair may not need replacement. If it is assumed that only half of infrastructure of the racks in poor condition would need to be replaced, such repair would result in the following. In 2013, 65,000-97,000 linear feet of lumber would be installed in Drakes Estero in addition to 1,700-2,500vertical 2-inch by 6-inch posts. In 2014, 14,000-29,000 linear feet of lumber would be installed in addition to 380-750 vertical 2-inch by 6-inch posts. DBOC proposes continued regular maintenance of its infrastructure following the initial wide-scale repairs (DBOC 2012b[xxxi]). It is estimated that DBOC would repair or replace 1,000-2,000 linear feet of lumber each year, and replace vertical posts as necessary.

DBOC has not indicated whether rack repairs under alternative B would result in additional boat use in Drakes Estero. Should this occur, the additional motorized boat use in Drakes Estero could lead to further degradation of fish and fish habitat due to potential damage to eelgrass beds. Posts installed into the bottom of Drakes Estero during rack repair would disturb the underlying substrate, leading to temporary and localized sedimentation in fish habitat. Standard sediment control BMPs would be implemented to reduce sediment erosion into neighboring wetlands or other waters. Further, due to regulatory permit conditions that would likely be associated with rack repair activity, this assessment assumes that the lumber used for rack repair would require an approved coating material in order to minimize the potential for release of copper leachates into the aquatic environment. However, due to a slightly detectable disruption of fish near racks, the impacts to fish and fish habitat associated with rack repair and/or replacement under alternative B would be expected to be short-term.

The offshore shellfish operation has historically caused mariculture debris such as floats, spacers, and tubes to unintentionally become dislodged and deposited in the aquatic environment of Drakes Estero. While realizing this as an ongoing possibility, the degree and intensity to which materials could become dislodged in the future is unknown. The conditions of the SUP and the CCC CDO would require that DBOC continue to work on removal of marine debris from shellfish mariculture equipment.

Under the assumption that limited incidental mariculture debris pollution would continue under alternative B, adverse impact to fish could result from ingestion of small fragments of synthetic debris when fish are unable to distinguish the debris from normal prey (Laist 1987). Ingested debris can inhibit digestion and remain in the stomach for long periods of time, which can effect fish through a reduction in appetite, injury to the stomach lining, or provide a potential source of toxic material (Laist 1987). Smaller fish could also become entrapped in PVC spacer or tubes, causing exterior abrasion or lacerations that could be potential avenues for infection (Laist 1987). These effects from mariculture debris could adversely impact fish communities in Drakes Estero by decreasing energy or health that may make fish more susceptible to predation, disease, and reduced breeding success (Laist 1987). However, without a direct measure of debris-related mortality, it is difficult to distinguish its potential effects on fish populations from those caused by other natural or human-influenced sources of mortality (Laist 1987).

Adverse impacts to fish related to sedimentation would also be expected to result from DBOC cleanup procedures should workers disturb the soft bottom of Drakes Estero when retrieving loose debris from intertidal mudflats; however, these impacts are not expected to cause a noticeable increase in sedimentation to the ongoing impacts related to general shellfish operation activities.

Based on the impacts described above, alternative B would result in long-term minor adverse impacts on fish for an additional 10 years because impacts on fish would be slightly detectable and would only affect a small segment of the population, their natural processes, and/or their habitat in the project area.

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 in 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, as discussed above, impacts on fish would be slightly detectable and would only affect a small segment of the population, their natural processes, and/or their habitat in the project area. While the natural species composition would remain altered due to the presence of nonnatural structured habitat, these alterations would be relatively localized and confined to the 7 acres of racks and would not affect the overall structure of any natural community. Additionally, eelgrass habitat fragmentation caused by 8.5 miles of DBOC motorboat propeller scars and 7 acres of oyster racks would have the potential to create a nonnatural spatial redistribution of fish that could locally influence the functionality of the fish habitat. The continued maintenance of shellfish racks would continue to displace approximately 7 acres of eelgrass habitat, which is essential fish habitat for Pacific groundfish identified in the Groundfish Plan (PFMC 2008). Shellfish rack repair and replacement would have the potential to degrade fish habitat by affecting water quality, but impacts would be short term due to a slightly detectable disruption of fish near racks. Assuming that fish would have a limited exposure to commercial shellfish operation debris pollution, adverse impacts on fish from the ingestion of small fragments or entrapment in PVC debris would be slightly detectable and would affect only a small segment of the population or their natural processes and/or habitat in the project area. The cumulative impact would be long term and beneficial, and alternative B would contribute a noticeable adverse increment to the overall beneficial cumulative impact.

With regard to fish, the continued operation of DBOC for 10 additional years would not be consistent with relevant law and policy. The continued maintenance of a nonnatural community in Drakes Estero would not further the goal of NPS *Management Policies 2006* to preserve and restore natural communities and ecosystems. The perpetuation of nonnatural 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, which is designated as essential fish habitat (habitat of particular concern) in 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 in 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. The production limits associated with alternative C (500,000 pounds of shellfish per year), would be less than the 600,000 pounds per year limit associated with alternative B, however, is not expected to result in any difference in impacts to fish or essential fish habitat since there is no proposal to expand racks beyond current areas.

Under alternative C, the impact on fish would be the same as that 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. DBOC's continued use of the 95 wooden racks, totaling approximately 5 miles (7 acres) in 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. Eelgrass habitat fragmentation caused by 8.5 miles DBOC motorboat propeller scars and 7 acres of oyster racks would have the potential to create a non-natural spatial redistribution of fish that could locally influence the functionality of the fish habitat. The wide-scale repair and replacement of shellfish racks, including repair of 50 racks in 2013 and another 25 racks in 2014 (DBOC 2012b [xxxii]), would result in short-term adverse impacts on water quality, fish, and fish habitat. The continued exposure to mariculture debris pollution would result in adverse impacts to fish from ingestion of small fragments or entrapment in PVC debris.

Based on the impacts described above, alternative C would result in long-term minor adverse impacts on fish for an additional 10 years because impacts on fish would be slightly detectable and would only affect a small segment of the population, their natural processes, and/or their habitat in the project area.

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 in 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, although the natural species composition would remain altered due to the presence of nonnatural 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. Eelgrass habitat fragmentation caused by 8.5 miles of DBOC motorboat propeller scars and 7 acres of oyster racks would have the potential to create a nonnatural spatial redistribution of fish that could locally influence the functionality of the fish habitat. The maintenance of shellfish racks would continue to displace approximately 7 acres of eelgrass habitat, which is identified as essential fish habitat for Pacific groundfish in the Groundfish Plan (PFMC 2008). The wide-scale repair and maintenance of shellfish racks would continue to have the potential to degrade water quality and affect the fish community, but impacts would be short term, minor, and adverse due to a slightly detectable disruption of fish near racks. Assuming that fish would have a limited exposure to commercial shellfish operation debris pollution, adverse impacts on fish from the ingestion of small fragments or entrapment in PVC debris would be slightly detectable and would affect only a small segment of the fish population or their natural processes and/or habitat in the project area. The cumulative impact would be long term and beneficial, and alternative C would contribute a noticeable adverse increment to the overall beneficial cumulative impact.

With regard to fish, the continued operation of DBOC for 10 additional years would not be consistent with relevant law and policy. The continued maintenance of a nonnatural community in Drakes Estero would not further the goal of NPS *Management Policies 2006* to preserve and restore natural communities and ecosystems. The perpetuation of nonnatural 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, which is designated as essential fish habitat (habitat of particular concern) in 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 in 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 associated with this alternative would be slightly larger than alternative B; however, DBOC's racks and bags would generally occupy the same cultivation beds. In addition, the production limit of 850,000 pounds of shellfish per year is not expected to result in a noticeable difference in impacts to fish or essential fish habitat because there is no proposal to expand racks beyond current areas.

The impact of alternative D 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. DBOC's continued use of the 95 wooden racks, totaling approximately 5 miles (7 acres) in 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. Eelgrass habitat fragmentation caused by 8.5 miles DBOC motorboat propeller scars and 7 acres of oyster racks would have the potential to create a non-natural spatial redistribution of fish that could locally influence the functionality of the fish habitat. The wide-scale repair and replacement of shellfish racks, including repair of 50 racks in 2013 and another 25 racks in 2014 (DBOC 2012b [xxxiii]), would result in short-term minor adverse impacts on water quality, fish, and fish habitat. The continued exposure to mariculture debris pollution would result in adverse impacts to fish from ingestion of small fragments or entrapment in PVC debris.

Based on the impacts described above, alternative D would result in long-term minor adverse impacts on fish for an additional 10 years because impacts on fish would be slightly detectable and would only affect a small segment of the population, their natural processes, and/or their habitat in the project area.

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 in 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, although the natural species composition would remain altered due to the presence of nonnatural 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. Eelgrass habitat fragmentation caused by 8.5 miles of DBOC motorboat propeller scars and 7 acres of oyster racks would have the potential to create a nonnatural spatial redistribution of fish that could locally influence the functionality of the fish habitat. The maintenance of shellfish racks would continue to displace approximately 7 acres of eelgrass habitat, which is essential fish habitat for Pacific groundfish in the Groundfish Plan (PFMC 2008). The wide-scale repair and maintenance of shellfish racks would continue to have the potential to degrade water quality and affect the fish community, but impacts would be short term, minor, and adverse due to a slightly detectable disruption of fish near racks. Assuming that fish would have a limited exposure to commercial shellfish operation debris pollution, adverse impacts on fish from the ingestion of small fragments or entrapment in PVC debris would be slightly detectable and would affect only a small segment of the fish population or their natural processes and/or habitat in the project area. The cumulative impact would be long term and beneficial, and alternative D would contribute a noticeable adverse increment to the beneficial cumulative impact.

With regard to fish, the continued operation of DBOC for 10 additional years would not be consistent with relevant law and policy. The continued maintenance of a nonnatural community in Drakes Estero would not further the goal of NPS *Management Policies 2006* to preserve and restore natural communities and ecosystems. The perpetuation of nonnatural 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, which is designated as essential fish habitat (habitat of particular concern) in 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 U.S. 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 in 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 in 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 in 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).

The impact analysis included in this section draws from a body of research originating from ongoing pinniped monitoring studies conducted by NPS as part of programs like the San Francisco Bay Area Network Inventory and Monitoring Program (e.g., NPS 2006c; Adams et al. 2009; Codde et al. 2011, 2012). The information available from this research includes data on seal counts, behavior, mortality, and potential disturbances of harbor seals in Drakes Estero and surrounding areas. NPS staff and volunteers participate in the monitoring efforts, and monitoring protocols are designed to be consistent from year-to-year to allow comparisons between years. Recognizing that some of the data provided in this program comes from volunteers and not scientists, the impact analysis in the EIS places emphasis on the data review, analysis, and interpretation of scientists in NAS (2009) and MMC (2011b). Both of these documents analyze the potential impacts of shellfish culture in Drakes Estero on harbor seals, as rendered

by experts in west coast pinniped ecology. Further, MMC (2011b) provides an in-depth review of the science and conclusions of research conducted by Becker, Press, and Allen (2009, 2011), which deals directly with shellfish culture and potential effects on the harbor seal population in Drakes Estero. Where studies on specific impacts (such as effects of sound on harbor seals) are lacking in Drakes Estero, this impact analysis draws from relevant research available in the scientific literature on those phenomena, with an emphasis on environmental settings similar to Drakes Estero. Documents considered in this review met the conditions of "primary reference" as described in Chapter 1: References Used for Impact Analysis (page 26).

Between spring 2007 and spring 2010 more than 250,000 digital photographs were taken from remotely deployed cameras overlooking harbor seal haul-out areas in Drakes Estero. These photographs are posted on the NPS web site at
http://www.nps.gov/pore/parkmgmt/planning_reading_room_photographs_videos.htm.

Based on public comments on the Draft EIS, the NPS initiated a third-party review of the photographs with the USGS, in consultation with a harbor seal specialist with the Hubbs-Sea World Research Institute. The USGS assessment (Lellis et al. 2012) focused on the 2008 harbor seal pupping season, when more than 165,000 photos were collected from two sites overlooking Drakes Estero between March 14, 2008 and June 23, 2008.

The USGS identified a series of limitations to the utility of the photos, including lack of study design, poor photo quality, inadequate field of view, incomplete estuary coverage, camera obstructions, and weather. Based on low image resolution and distance between the camera and the seals, the USGS noted that with the exception of seal flushing events into or towards water, it was not possible in most cases to distinguish behavior among individual seals that could be attributed to increased vigilance in response to a stimulus, (e.g., head alerts or other alert behavior). The USGS assessment identified 10 flushing disturbance events at the oyster bar (OB) site in 2008. As noted, no other level of disturbance, such as increased vigilance could be detected from the photos or videos. The USGS assessment attributed a specific stimulus to six of the ten observed flushing disturbance events. Two flushing disturbance events were attributed to boat traffic at nearby sand bars, two were attributed to kayak use of the lateral channel during the harbor seal closure period, and two were attributed to seabirds landing among the seals. As noted no other level of disturbance, such as increased vigilance could be detected from the photos or videos.

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 study was concluded in 2011, and the results of this review are provided in MMC (2011b). The MMC pursued one primary line of inquiry into the issue of potential human effects on natural habitat in Drakes Estero: whether shellfish operations are adversely affecting harbor seals and, if so, to what extent. To accomplish this, the MMC analyzed available sources of data on the issue, including seal counts and disturbance records from NPS staff and volunteers, photographs, oyster production records, seal mortality observations, and aerial images. In addition, the MMC reviewed the validity of scientific publications that specifically address harbor seals in Drakes Estero, namely, Becker, Press, and Allen (2009, 2011). In summarizing the results of the study, MMC (2011b) describes several data gaps and recommends research and management activities to reduce the level of uncertainty surrounding this issue. With respect to sources of information derived from NPS records and research, the MMC provided the following interpretations: (1) due to the variability of seal

count data, NPS records by themselves are not sufficient to determine factors that caused changes in seal numbers; (2) statistical procedures used in NPS publications [particularly Becker, Press, and Allen (2011)] were generally appropriate but could be improved; and, (3) Becker, Press, and Allen (2011) provides "…some support for the conclusion that harbor seal habitat-use patterns and mariculture activities in Drakes Estero are at least correlated. However, the data and analyses are not sufficient to demonstrate a causal relationship" (MMC 2011b). As a component of its review, MMC (2011b) conducted some additional statistical analyses based on recommendations from an independent statistician. This included consideration of other potential influences on seals such as environmental conditions, and the impacts of an aggressive seal at a nearby colony outside of Drakes Estero. After reviewing the results of these additional analyses, the MMC concluded that its results "…continue to support the hypothesis that oyster harvest…is at least correlated with seal use of the different haulout sites in Drakes Estero" (MMC 2011b).

Intensity Definitions

Negligible: The impact is not detectable or measurable.

Minor: Impacts on harbor seals would be slightly detectable and would only affect a small segment of the population, natural processes, or habitat in the project area.

Moderate: Impacts on harbor seals would result in readily apparent effects on the population, natural processes, or habitat in the project area.

Major: Impacts on harbor seals would result in readily apparent and substantial effects on the population, natural processes, or habitat in the project area. Loss of habitat or consistent disruptions may affect the viability of the species or cause the population to relocate outside the project area.

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.

During harbor seal pupping season all boat access is prohibited with the exception of DBOC boats. The elimination of DBOC boat traffic in Drakes Estero (approximately 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 Drakes 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; Acevedo-Gutierrez and Cendejas-Zarelli 2011). Post mortem results from pups recovered from the mouth of Drakes Estero did not exhibit the signs of malnutrition or infection often seen in stranded seal pups, suggesting that separation was quickly followed by death and not related to infectious disease (MMC 2011b). Due to the removal of potentially disruptive activities associated with DBOC in Drakes Estero, alternative A would be expected to result in beneficial impacts on harbor seals.

Research on marine debris and its effects on wildlife indicate that marine mammals like harbor seals have been known to inadvertently consume plastic debris, which they sometimes mistake for food (Laist 1987; Williams, Ashe, and O'Hara 2011). As stated in Williams, Ashe, and O'Hara (2011), "[i]ngestion of debris may cause a physical blockage in the digestive system to the point of starvation, introduce toxic chemicals into the tissues of animals that consume it, or may cause the animal to feel satiated and reduce its foraging effort." Marine debris from damaged commercial shellfish operation infrastructure has been known to become dislodged and be found floating in Drakes Estero or washed up on mudflats and shorelines. Under this alternative, harbor seals would benefit from the removal of all racks and bags, thereby eliminating the potential for ingestion of commercial shellfish operation debris pollution.

The removal of shellfish infrastructure from Drakes Estero may require the increased use of motorboats for a period of 2-3 months outside of the harbor seal pupping season. This disturbance would continue to generate the human-caused noise that could disrupt 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, following standard practices, to prevent all boat-related recreational access to Drakes Estero during harbor seal pupping season (March 1- June 30 annually), including canoes and kayaks. Access to the shoreline by foot would continue. This restriction on recreational access to Drakes Estero would be expected to have beneficial impacts on harbor seals, since it would deter recreational canoeing/kayaking – activities that have been documented as a source of disturbance to harbor seals (Becker, Press, and Allen 2011; MMC 2011b). 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.

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 in Drakes Estero. Alternative A could also result in short-term minor adverse impacts associated with rack removal, which would be localized, slightly detectable, and would not affect the overall structure of the natural community (i.e., would only affect a small segment of the harbor seal population, natural processes, or habitat in the project area).

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact harbor seals and harbor seal habitat in 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 (Becker, Press, and Allen 2011; MMC 2011b). As such, continued kayaking in Drakes Estero would result in minor adverse impacts on harbor seals. While harbor seal disturbances could still occur outside of the pupping season, kayaks would not be allowed into Drakes Estero during the critical pupping season.

Some limited use of motorized boats in Drakes Estero may take place for research or administrative purposes. Any motorboat use for research or administrative purposes 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 in 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 in 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 in Drakes 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 in Drakes Estero. Disturbance to harbor seals would be limited to recreational kayakers (outside of the harbor seal pupping season), hikers on the adjacent landscape and shoreline, and aircraft. Further, the termination of shellfish operations in Drakes Estero could benefit the distribution and abundance of the native harbor seal population, and could result in expansion of available habitat for harbor seals.

Alternative A could also result in short-term minor adverse impacts associated with rack removal, which would be localized and slightly detectable but would not affect the overall structure of the natural community (i.e., would affect only a small segment of the harbor seal population, natural processes, or habitat in the project area). These activities would be conducted outside the harbor seal pupping season to minimize adverse impacts. The cumulative impact would be long term and beneficial, including the

removal of marine debris from Drakes Estero, and alternative A would contribute an appreciable beneficial increment to the overall cumulative impact.

With respect to harbor seals, alternative A would be consistent with NPS policy because the removal of DBOC operations from Drakes Estero would remove an unnatural stimulus that is correlated with changes in harbor seal behavior. Similarly, the decrease in potential disturbance of this species would be consistent with MMPA (16 USC 1361 et seq., 1401–1407, 1538, 4107) by avoiding any potential take (as described above) of marine mammals and by maintaining the health and stability of the marine ecosystem.

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 in 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 motorized boat traffic year-round, including during the harbor seal pupping season

DBOC operations would continue to be subject to the harbor seal protection protocol stipulated in the SUP. This protocol prohibits boat travel and general operations, including the placement of bags, moorings, and installation of floating racks in the established harbor seal protection areas (see figure 3-5). Other restrictions 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 shellfish beds from harbor seal protection areas 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 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 Drakes Estero, and the ability of DBOC staff to reasonably see and recognize a hauled-out harbor seal. Specific information related to noise distribution in Drakes Estero is evaluated in the “Impacts on Soundscapes” section. DBOC employees would continue to access offshore structures in 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 areas depicted on figure 3-5.

The continuation of DBOC activities would include the operation of at least two motorboats in the permit area (approximately eight hours a day, six days a week, year-round) and the continued 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 based on documented correlations between shellfish operations and harbor seal behavior in Drakes Estero (NAS 2009; Becker, Press, and Allen 2011; MMC 2011b).

Under alternative B, DBOC would repair or replace 50 inactive-dilapidated racks in 2013 and repair an additional 25 active racks in 2014 (DBOC 2012b[xxxiv]). DBOC would be required to make repairs to the racks between July 1 and February 28 to avoid the harbor seal pupping season. DBOC has not indicated whether rack repair would result in additional boat use in Drakes Estero, although assuming rack repair would occur during regular DBOC operations, there would be potential for increased boat traffic during the 2 years of repairs (i.e., 2013-2014). Impacts on harbor seals from rack repair and/or maintenance would be expected to be short-term minor adverse due to increased boat use and human activity in Drakes Estero.

Under the assumption that limited incidental mariculture debris pollution would continue, alternative B would be expected to have adverse impacts on harbor seals due to the potential for ingestion (Laist 1987; Williams, Ashe, and O'hara 2011).

During the harbor seal pupping season (March 1 through June 30), DBOC boats are the only boats (motorized or nonmotorized) permitted in Drakes Estero. Drakes 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 shellfish operation-related disturbances to continue during important harbor seal reproductive periods. Long-term research on shellfish operations in Drakes Estero suggests that boat traffic and other actions related to DBOC operations are negatively correlated with harbor seal use of haul out areas near shellfish cultivation sites (Becker, Press, and Allen 2011; MMC 2011b).

The adverse effects of human-induced disturbance to harbor seals have been observed in other California bays (Grigg et al. 2002), in west coast locales (Suryan and Harvey 1999; Jansen et al. 2006Johnson and Acevedo-Gutierrez 2007; Acevedo-Gutierrez and Cendejas-Zarelli 2011), 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). 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). Further, there may be impacts on harbor seals related to underwater sounds produced by DBOC based on previous research on other marine mammals (NAS 2003). In a recent review of the long-term data for 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 cultivation sites during years of high vs. low oyster harvest.

As described under "Methodology" above, a recent MMC (2011b) review of shellfish operation effects on harbor seals in Drakes Estero concluded that Becker, Press, and Allen demonstrated a negative correlation between shellfish operations and seal use of haul-out sites, but noted that this correlation did not necessarily imply causation. Further, after examining individual disturbance records, MMC (2011b) concluded that, "from time to time, shellfish operation activities have disturbed the seals. However, the data used in the analysis are not sufficient to support firm conclusions regarding the rate and significance of such disturbance" (MMC 2011b). Additionally the USGS assessment (Lellis et al. 2012) of the more than 250,000 digital photographs taken from remotely deployed cameras overlooking harbor seal haul-out areas in Drakes Estero attributed a specific stimulus to 6 of the 10 observed flushing disturbance events. Two flushing disturbance events were attributed to boat traffic at nearby sand bars, two were

attributed to a kayak using the lateral channel (note kayak was in Drakes Estero in violation of seasonal closure), and two appeared to be related to seabirds landing among the seals.

Alternative B would result in long-term moderate adverse impacts on harbor seals for another 10 years due to the seal displacement effects of human activities in Drakes Estero associated with DBOC's operation, and the potential for disturbances known to disrupt harbor seal behavior. These impacts would be readily apparent and would affect populations, natural processes, and/or habitat of harbor seals in the project area.

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 in 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 the continuation of commercial shellfish operations in 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 disturbance of harbor seals 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 as part of the new 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 be correlated with harbor seal behavior. These impacts would be readily apparent and would affect populations, natural processes, and/or habitat of harbor seals in the project area. Impacts related to rack repair and replacement activities in 2013 and 2014 would be slightly detectable and therefore short term, minor, and adverse. The potential for the continued introduction of marine debris into the environment would have adverse impacts on harbor seals due to the potential for ingestion. The cumulative impact

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

With respect to harbor seals, alternative B would 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* 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). 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 in 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, impacts would be expected to be the same as described under alternative B. DBOC's racks and bags would occupy the same cultivation beds 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 year-round disturbance of harbor seals by DBOC operations, which have been shown to be negatively correlated with harbor seal use of haul-out sites in Drakes Estero. Further, as discussed under alternative B, repair/replacement of racks in 2013 and 2014 would result in short-term negative effects on harbor seals, and the potential for continued introduction of mariculture debris into Drakes Estero would result in negligible adverse impacts on harbor seals. These impacts 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 seal displacement effects and the potential for disturbances that are known to disrupt harbor seal behavior. These impacts would be readily apparent and would affect populations, natural processes, and/or habitat of harbor seals in the project area.

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 in 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 the continuation of commercial shellfish operations in 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 disturbance of harbor seals 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 new 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 be correlated with harbor seal behavior. These impacts would be readily apparent and would affect populations, natural processes, and/or habitat of harbor seals in the project area. Impacts related to rack repair and replacement activities in 2013 and 2014 would be slightly detectable and therefore short term, minor, and adverse. The potential for the continued introduction of debris from the commercial shellfish operation into the environment would have adverse impacts on harbor seals due to the potential for ingestion. The cumulative impact would be long term, moderate, and adverse, and alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to harbor seals, alternative C would not further the goals of relevant law and policy because continued DBOC operations in Drakes Estero would maintain an unnatural stimulus that is negatively correlated with harbor seal use of haul-out sites. 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 in 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 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 in 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 seal displacement effects and the potential for disturbances that are known to disrupt harbor seal behavior. 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 as impacts to harbor seal populations, natural processes, and/or habitat in the project area would remain readily apparent. Further, as discussed under alternative B, repair/replacement of racks in 2013 and 2014 would result in slightly detectable short-term minor adverse impacts on harbor seals, and the potential for continued introduction of commercial shellfish operation-related debris into Drakes Estero would result in negligible adverse impacts on harbor seals.

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 in 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 the continuation of commercial shellfish operations in 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 disturbance of harbor seals 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 new 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 be correlated with harbor seal behavior. These impacts would be readily apparent and would affect populations, natural processes, and/or habitat of harbor seals in the project area. Impacts related to rack repair and replacement activities in 2013 and 2014 would be slightly detectable and therefore short term, minor, and adverse. The potential for the continued introduction of debris from the commercial shellfish operation into the environment would have adverse impacts on harbor seals due to the potential for ingestion. 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); however, these impacts are still expected to be moderate in intensity. The cumulative impact would be long term, moderate, and adverse, and alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

With respect to harbor seals, alternative D would 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 in 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 in or across international borders at some point during their annual life cycle.

Under the NPS Organic act, as amended and supplemented, other NPS statutes, and the NPS *Management Policies 2006*, the responsibility of the NPS to protect migratory birds and their habitat extends beyond the minimum definition of "take" in the MBTA. NPS has a commitment to regional conservation planning. NPS *Management Policies 2006* for biological resource management (NPS 2006d, section 4.4 et seq.) also states, "in addition to maintaining all native plants and animal species and their habitats inside the parks, the Service will work with other land managers to encourage the conservation of the populations and habitats of these species outside parks wherever possible. To meet its commitments for maintaining native species in parks, the Service will cooperate with states, tribal governments, the U.S. Fish and Wildlife Service, NOAA fisheries, and other countries, as appropriate to…participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d).

NPS is required by Executive Order 13186 to protect migratory birds and these responsibilities are expressed in detail in a Memorandum of Understanding (MOU) between the NPS and USFWS (NPS and

USFWS 2010). This MOU establishes how the NPS and UWFWS will jointly promote the conservation of migratory birds by incorporating migratory bird conservation measures into agency actions and planning activities. In order to meet management and legal responsibilities, the MOU requires that NPS develop the capability to identify, plan for, and mitigate actions that adversely affect migratory bird population in NPS boundaries, and to work with other entities in the birds' ranges to increase awareness of migratory bird issues. The purpose of the MOU is to:

> "…strengthen migratory bird conservation by identifying and implementing strategies intended to complement and support existing efforts, and facilitate new collaborative migratory bird conservation partnerships and comprehensive planning strategies for migratory birds. This includes planning efforts and activities of bird initiatives, such as the Partners in Flight American Landbird Conservation Plan, the U.S. Shorebird Conservation Plan, the North American Waterbird Conservation Plan, and the North American Waterfowl Management Plan. Planning efforts include those initiated through Joint Ventures (JVs), the North American Bird Conservation Initiative (NABCI), and the FWS's Strategic Habitat Conservation (SHC) and the Landscape Conservation Cooperative (LCC) planning frameworks." (NPS and USFWS 2010)

Strategies incorporated into bird conservation initiatives are based on collaborative assessments and recognition of conservation value determined by the scientific community, such as the Southern Pacific Shorebird Conservation Plan (Hickey et al. 2003) designation of the Drakes Estero and Estero de Limantour system as a Site of Regional Importance (Hickey et al. 2003) and the North American Waterbird Conservation Plan designation of the Seashore (including Drakes Estero) as an Important Bird Area (Kushlan et al. 2002).

Strategies and conservation goals are generally created based on conservation value and can be species or habitat specific. For example, the recommended habitat goal of the Southern Pacific Shorebird Conservation Plan (Hickey et al. 2003) is to increase the extent and quality of tidal flats for shorebirds. In order to increase the habitat quality of tidal flats, the plan recommends that human activities (including kayaking and oyster culture) be restricted and that further alteration of tidal flats for oyster cultivation should be prohibited (Hickey et al. 2003).

METHODOLOGY

This section summarizes the impacts on birds from the actions that would potentially occur under each alternative. Information used to complete the analysis of impacts was taken from studies of the bird population of Drakes Estero, as well as from other local and regional studies performed for birds and bird habitats that are similar to those found in the project area. Bird inventories performed by the Point Reyes Bird Observatory (White 1999) were used for data regarding waterbird and shorebird species in Drakes Estero, and to analyze the local and regional distribution of these species in other similar environments. Additional data was gathered from studies performed to ascertain the seasonal abundance of shorebirds (Shuford et al. 1989) in the Seashore and Drakes Estero. These studies reflect the abundance of data that is available regarding birds that use Drakes Estero and other coastal estuaries along the Pacific Flyway.

Analysis of the potential effect of human disturbance on waterbirds and shorebirds is also readily available; however, few studies have been performed in estuaries similar to Drakes Estero that are also influenced by the presence of shellfish mariculture. This is due to the diversity and complexity of bird populations and their habitat, the variety of types of shellfish that are grown in mariculture, and the high variability in culture methods used to grow shellfish commercially. These differences are important to recognize due to the fact that bird behavior is often species-specific and site-specific. Since many species in Drakes Estero migrate along the Pacific Flyway, additional complexity is recognized in the analysis these birds due to spatial and temporal fluctuations.

In regard to these complexities, the studies reported in Kelly et al. (1996) were particularly useful in obtaining data regarding certain shorebirds and their response to shellfish mariculture. This study was conducted in a similar, local estuarine setting (Tomales Bay) that contains oyster mariculture techniques similar to those used in Drakes Estero. Additionally, based on the bird inventories described above, many of the bird species studied in Tomales Bay are the same as those found in Drakes Estero. Due to the number and type of other bird species that use habitat in the project area, other information was needed to analyze the effects of each alternative on factors such as bird response to different types of human disturbance. In this regard, bird behavior in response to human disturbance has similarity to other environmental stimuli, therefore, a more thorough analysis of data from multiple types of environmental stimuli and human disturbance was possible.

Since the importance of shorebird and waterbird conservation is well recognized by government agencies and non-governmental organizations, additional data was used from several regional and national conservation plans. While information in these plans is not always presented on the local level with a high level of specificity, they often present detailed information regarding descriptions of individual species and populations, behavior, habitat characteristics, and birds or bird habitats that have special conservations value.

In consideration of the populations of shorebirds and waterbirds found in 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. This section evaluates both short-term and long-term direct and indirect impacts based on the following:

Intensity Definitions

Negligible:	The impact is not detectable or measurable.
Minor:	Impacts on birds would be slightly detectable and would affect a small segment of the populations, their natural processes, or habitat in the project area.
Moderate:	Impacts on birds would result in readily apparent effects on populations, natural processes, or habitat in the project area.
Major:	Impacts on birds would result in readily apparent effects and would substantially influence bird populations, natural processes, or habitat in the project area. Loss of habitat or consistent disruptions may affect the viability of the species or cause populations to relocate outside the project area.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations expire on November 30, 2012. As described in chapter 2, DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property.

The termination of DBOC operations and removal of associated facilities and infrastructure would have beneficial impacts on the birds and bird habitat present in Drakes Estero. As described in chapter 3, Drakes Estero is a major foraging and resting location for resident and migratory birds (Shuford et al. 1989) that use the project area. The foraging and resting habitat includes intertidal beaches, intertidal flats, brackish marshland, and open subtidal waters, which attract resident and migratory bird populations due to a high abundance of available prey species and protection from predators. Abundant populations of American wigeon, bufflehead, ruddy duck, willet, western sandpiper, least sandpiper and dunlin have been recorded during mid-winter counts (White 1999). Other common species in Drakes Estero are described in chapter 3, as well as species of greater conservation concern such as the Pacific black brant and American white pelican.

DBOC bottom cultivation methods, including bags and trays, would potentially cover up to 88 acres of intertidal areas (approximately 22 acres of bags were planted in both 2009 and 2010 according to DBOC proof-of-use reports) and may prevent some birds, such as dunlin and sandpipers, from foraging for prey species that live in the underlying substrate. NAS (2009) states that by terminating bottom bag cultivation in Drakes Estero, foraging birds would no longer be prevented from accessing the sediments directly underneath bags (NAS 2009). Further, an investigation of shorebirds in Tomales Bay concluded that a significant net decrease in total shorebird use of foraging habitat resulted in tidal flats developed for oyster cultivation (Kelly et al. 1996). Based on the conclusions from the Tomales Bay study (Kelly et al. 1996), alternative A would result in beneficial impacts by improving available foraging habitat and reverting tidal flats to more natural conditions, allowing increased shorebird foraging in that habitat (see discussion under alternative B).

Bags and trays used in bottom cultivation methods may also prevent the use of intertidal areas as roosting and resting habitat for some waterbird species found in Drakes Estero, such as pelicans and cormorants (White 1999). The value of their roosting and resting habitat in Drakes Estero is accentuated by the isolation from predators and proximity to open water foraging habitat. Since they forage in water, roosting habitat also provides pelicans and cormorants an opportunity to dry out and prevent hypothermia (McChesney 2008). As a result, these waterbirds would benefit from the removal of bottom cultivation operations in this alternative due to the added availability of valuable roosting and resting habitat, as well as workers travelling by foot across intertidal areas and boats that serve as potential sources of disturbance.

Alternative A would also benefit waterbird species by allowing the protection of eelgrass beds as key bird habitats. Eelgrass beds provide important winter feeding opportunities for the Pacific black brant (Davis and Deuel 2008), as well as surface-feeding ducks and other waterfowl species. Eelgrass also supports an abundance of estuarine prey species used by many waterbird species to meet their energy requirements

(Kelly and Tappen 1998, Weathers and Kelly 2007). The removal of oyster racks (95 racks occupying approximately 5 linear miles or 7 acres) under alternative A would also allow the natural eelgrass habitat a chance to regenerate, potentially providing benefits to birds that use eelgrass bed specifically for foraging.

In particular, brant rely on eelgrass as their principle food source during migration (Davis and Deuel 2008). Brant prefer to forage in the deeper waters close to large tidal channels (Davis and Deuel 2008) where shellfish cultivation racks are commonly located. In the absence of shellfish racks, brant could expand their use of eelgrass beds and adjacent flats, which would have greater importance when populations are highest (during spring migration). Additionally, disturbances caused by motorboats accessing these racks would be removed under alternative A, providing benefits to waterbirds and waterfowl, including the brant. A coinciding benefit to spring-migrating brant under alternative A would be associated with a gate to assist NPS in enforcing the existing seasonal closure of Drakes Estero to all recreational boat access during harbor seal pupping season, which would further serve to prohibit kayaker use of the large tidal channels.

The removal of shellfish racks under alternative A also could negatively affect some bird species. The racks have potential to provide food sources and other habitat, such as roosting structures (Forrest et al. 2009). Food sources for birds may include organisms that grow on the hard substrate provided by clustered oysters or the rack apparatus, and elevated roosts provided by racks may be utilized by birds as resting habitat (Hilgerloh et al. 2001). However, the loss of benefits provided by shellfish racks under alternative A must also consider the elimination of potential negative effects of other shellfish operation activities, such as the potential for motorboats in Drakes Estero to flush birds (i.e. cause birds to abruptly fly away) from roosting structures as the boats approach the racks. The removal of the racks under alternative A would increase natural habitat for birds in Drakes Estero.

Alternative A would benefit birds by removing disturbance to normal biological behavior related to the DBOC motorboats. Greater detail on the level of this type of disturbance to birds produced from motorboats is provided in alternative B below. Similar to other unnatural human stimuli, motorized vehicles (such as motorboats) can cause disturbance to animals because the presence of the vehicle is often perceived as a predatory threat. Prey species have developed antipredator responses (e.g. avoidance, defense, etc.) to threatening stimuli, such as loud noises and rapidly approaching objects (Frid and Dill 2002). In this way, the noise stimulus from motorboats could be perceived as an auditory threat to birds, while the physical presence of motorboats could be perceived as a visual threat. While the natural ambient and background sounds in Drakes Estero are likely to occasionally disturb birds, this type of disturbance typically does not elicit the same level of response as motorboats. The removal of shellfish infrastructure from Drakes Estero could require the use of motorboats for a period of 2 to 3 months. This disturbance would temporarily continue to generate the human-caused noise that currently disrupts birds.

The effect of removal of shellfish operations and structures in the project area would also serve to restore the natural tide-dependent foraging needs of many shorebirds. In general, shorebirds must routinely move among and across feeding areas as intertidal substrates are exposed and inundated by receding or advancing tides (Kelly 2001). As a result, the shellfish operation-related loss of foraging opportunity may be heightened at particular tide levels, especially as water ascends or descends through structures that limit foraging behavior.

This alternative would also be expected to benefit birds by removing a source of pollution that can harm some bird species. Marine debris from damaged mariculture infrastructure has become dislodged and found floating in Drakes Estero or washed up on mudflats and shorelines. Under this alternative, birds would benefit from the removal of all racks and bags , thereby eliminating the potential ingestion of mariculture debris pollution.

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 in Drakes Estero. Alternative A may also result in short-term minor adverse impacts on birds because impacts related to rack removal would occur for 2 to 3 months but would affect a small segment of the populations, their natural processes, and habitat in the project area.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact birds and bird habitat in 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. Wetland restoration 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 activities would result in long-term beneficial impacts on birds and bird habitat. Recent coastal watershed restoration efforts in 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 in the project area.

Nonmotorized boats, including kayaks, are known to cause birds to flush. Continued kayaking in Drakes Estero would result in minor adverse impacts on birds in eight months of every year (i.e. the time outside of the management closure of Drakes Estero from approximately June to February). Additionally, planning and management activities may authorize use of motorized boats in 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, continued 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 in 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 in Drakes 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 in Drakes Estero and its associated human activities. The removal of DBOC motorboats and related activities would minimize the disruption of biological activities such as foraging and resting for various types of birds that use Drakes Estero. Intertidal areas previously used by DBOC for the bottom bag cultivation in commercial operations would result in up to 88 additional acres of foraging, roosting, and resting habitat for resident and migratory birds. This increase in bird habitat would have greater importance for spring migrating birds, like the Pacific black brant, and natural processes would be enhanced due to the closure of Drakes Estero to all recreational boat access during the seal pupping season (March 1 – June 30). Alternative A may result in adverse impacts on birds from rack removal, due to the removal of food sources and resting habitat associated with the racks. However, these adverse impacts would be expected to be short term and minor because they would affect a small segment of bird populations, their natural processes, and habitat in the project area. Further, the removal of shellfish racks would eliminate unnatural habitat features and restore natural bird habitats in Drakes Estero. Under this alternative, birds would benefit from the removal of all racks and bags, thereby eliminating the potential for ingestion of debris from the commercial shellfish operation. Cumulative impacts would be long term and 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* 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" and "participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d). The MBTA (16 USC 703–712, as amended) makes it illegal for people to "take" migratory birds, or their eggs, feathers, or nests. Additionally, alternative A would be consistent with Executive Order 13186 and the NPS MOU with USFWS, which directs agencies to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions (NPS and USFWS 2010).

As described in Hickey et al. (2003) and other bird conservation plans, because of restrictions on human activity (including kayaking and shellfish operations during the March 1 – June 30 seal pupping closure) and further alteration of tidal habitat, alternative A would be expected to support the recommended habitat goal of increasing the extent and quality of tidal flats for shorebirds (Hickey el al. 2003). Alternative A would also be expected to support the primary regional conservation goal of the U.S. Shorebird Conservation Plan to maintain the quality and quantity of habitat at local levels in order to support birds that breed, winter in, and migrate through each region (Brown et al. 2001). As such, the

removal of DBOC shellfish operations would be expected to positively influence birds and bird habitat by supporting conservation strategies outlined in bird conservation plans.

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 in 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 motorized boat traffic
-

While the multitude of bird species, populations, and habitats across the Seashore are well documented, data reflecting shellfish operation impacts on birds in Drakes Estero are limited. In its concluding statements on the effects of shellfish operations 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."

NAS (2009) also notes that oyster bags placed on intertidal flats prevent probing shorebirds (i.e., birds with long bills used to forage on benthic fauna) from accessing benthic prey species in sediments beneath the bags. While specific studies have not been conducted to show the relationship between shellfish operations and birds in the project area, in a similar estuarine setting (Tomales Bay) near Drakes Estero, a five-year investigation of the effects of shellfish operations (including use of bottom cultivation methods) on shorebirds indicated that shellfish operations degraded shorebird habitat quality and altered foraging behaviors (Kelly et al. 1996). Similarities between Drakes Estero and Tomales Bay include the estuarine setting, shellfish cultivations methods, bird populations, and types of bird habitat.

The results of the Tomales Bay study showed that that bottom cultivation methods can alter shorebird use of tidal flat habitat by enhancing foraging opportunities for some species, like the willet (Kelly et al. 1996). However, the results also revealed decreased foraging opportunities for other species, such as the dunlin and western sandpiper (Kelly et al. 1996). When considering all species observed and their abundance, the Tomales Bay investigation concluded that a net decrease in total shorebird use of foraging habitat resulted in tidal flats developed for shellfish operations (Kelly et al. 1996).

Due to the similarities between Drakes Estero and Tomales Bay, it can be inferred that a similar effect

would occur in shorebird use of foraging habitat in tidal flats developed for shellfish operations in Drakes Estero. While NAS (2009) states that only obligate probers (i.e. birds that forage primarily by probing) are likely to experience negative effects from shellfish operations on intertidal flats in Drakes Estero (NAS 2009), studies show that probing shorebirds are some of the most dominant bird species found in Drakes Estero. This is evidenced by the winter bird 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 (White 1999). Therefore, due to the abundance of probing shorebirds in Drakes Estero, it is likely that a net decrease in total shorebird use of foraging habitat in tidal flats used for shellfish operations also occurs in Drake Estero. Alternative B would continue these negative impacts. The mechanisms causing this net reduction could be related not only to the continued presence of shellfish operation-related structures preventing shorebird access to the substrate directly below bottom bags and other structures, but also to the reduction of shorebird use of foraging habitat adjacent to these structures (Kelly et al. 1996). In addition, the continued presence of shellfish cultivation bags and racks could obstruct visibility that shorebirds require for flock foraging behavior as well as for detecting predators (Kelly et al. 1996). Further, the availability and/or abundance of the preferred shorebird prey can be altered by shellfish operations (Trianni 1996). Physical avoidance of shellfish bags and racks as foraging substrates could also cause reduction in foraging habitat use (Kelly et al. 1996).

Under this alternative, DBOC bottom culture methods (including bags and trays) would continue to cover up to approximately 84 acres of intertidal substrate. Based on observations by Kelly et al. (1996), a reduction of foraging habitat quality and shorebird use resulting from bottom culture methods would occur in the project area under alternative B due to the continued operations of DBOC. It is likely that shorebirds would also avoid the substrate adjacent to bottom bags, further reducing habitat quality under alternative B. Further, bottom culture in intertidal areas would likely continue to limit the availability of valuable roosting and resting habitat for species such as pelicans and cormorants. Therefore, due to the abundance of probing shorebirds that would normally forage on benthic prey covered by (or in the vicinity of) shellfish culture bags, as well as the placement of bags in roosting and resting habitat of waterbirds, 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 birds and bird habitat in Drakes Estero.

Other DBOC structures that affect bird populations in Drakes Estero include shellfish racks. As described in the "Impacts on Eelgrass section," displacement of eelgrass habitat by the 95 wooden racks totals approximately 5 miles (7 acres) in Drakes Estero. While the racks offer some additional food sources and beneficial resting habitat for some species (Forrest et al. 2009), the racks are unnatural features and displacement of eelgrass reduces a food source for other species. Eelgrass beds are the main food source for the Pacific black brant (Davis and Deuel 2008), therefore, the continued presence of these racks under alternative B could have negative implications related to the distribution or population dynamics of the brant (Ganter 2000).

Under the assumption that limited incidental commercial shellfish operation-related debris pollution would continue under alternative B, adverse impact to birds could result from ingestion of small fragments of synthetic debris when birds are unable to distinguish the debris from normal prey (Laist 1987). Ingested debris can inhibit digestion and remain in the stomach for long periods of time, which can effect birds through a reduction in feeding stimuli, inhibited digestion, or by absorption of toxic material (Laist 1987; Azzarello and Van Vleet 1987). These effects from the debris pollution could adversely impact bird communities in Drakes Estero by decreasing energy or health that may make some bird

species more susceptible to predation, disease, and reduced breeding success (Laist 1987; Azzarello and Van Vleet 1987). However, without a direct measure of debris-related mortality, it is difficult to distinguish its potential effects on bird populations from those caused by other natural or human-influenced sources of mortality (Laist 1987).

Adverse impacts related to disturbance of birds in resting, roosting, and foraging habitat would also be expected to result from ongoing DBOC cleanup procedures should workers be perceived as auditory or visual threats when retrieving loose debris from intertidal mudflats; however, these impacts are not expected to cause a noticeable increase in bird disturbance in comparison to the ongoing impacts related to general shellfish operation activities.

Continued use of DBOC motorboats also has the potential to negatively affect foraging behavior of brant. When maneuvering throughout Drakes Estero to access culture beds, motorboat operators travel along routes in subtidal channels in order to reduce eelgrass impacts. Consequently, these subtidal channels have the highest frequency and duration of DBOC motorboat travel in Drakes Estero. This heightens the potential for disturbance to brant, which prefer to forage in the deepest areas permitted by tides in eelgrass beds that are close to large tidal channels (Davis and Deuel 2008). Moreover, shellfish racks located near subtidal channels overlap the brant's preferred foraging habitat, reducing their food source availability through displacement of eelgrass habitat and reducing foraging efficiency by means of increasing the potential for flushing or other motorboat-related disturbance. Disturbance caused by motorboats during foraging is related to behavioral response mechanisms such as the perception of these boats as auditory (i.e. noise) and/or visual threats. Studies have shown that disturbance from motorboats can cause some birds to stop feeding or fly away from foraging habitat (Smit and Visser 1993). Depending on the level of disturbance, brant could also experience interrupted feeding or leave the foraging location completely (Stock 1993). The latter result is reiterated by the Pacific Flyway Council (2002), which states that the brant’s sensitivity to disturbance could cause immediate departure from a feeding or resting location.

This reaction to disturbance could be especially detrimental during spring-migration, when brant use Drakes Estero as a staging site. Energy expended as a result of disturbance, coupled with displacement of their primary food source, likely decreases the foraging efficiency of the brant. This can affect the energy supply required for the birds to adequately store fat for migration and breeding (Stock 1993). Because brant are not able to store enough energy reserves to allow non-stop migration from wintering to breeding grounds (Ganter 2000), they must use estuarine staging sites like Drakes Estero that have suitable eelgrass foraging habitat (Pacific Flyway Council 2002) to feed, rest, and restore depleted energy reserves. Successful staging behavior allows brant to complete migration and begin the early stages of breeding (Ganter 2000).

Flushing and other disturbance attributed to shellfish operations in Drakes Estero also affect other bird species. As stated in alternative A, NAS (2009) state that “boat travel by the mariculturists is likely to disturb and flush seaducks, shorebirds, and other waterbirds”, and the presence of boats in eelgrass prevents waterbirds from congregating in that area (Kelly and Tappen 1998). DBOC motorboats make approximately 12 trips per day (amounting to approximately 1,500 trips per year) to destinations throughout the project area, although boat traffic may vary depending on factors such as demand and weather (DBOC [Lunny], pers. comm., 2011h, 2012b[xxxv]). DBOC’s motorboats are estimated to produce sound levels between 62 and 74 dBA at 50 feet. Use of boats at these levels could take between 0.2 miles (1,203 feet) and 0.8 miles (4,269 feet) for the noise to decrease to the ambient soundscape (34 dBA). Detail related to soundscapes is provided in the “Impacts on Soundscapes” section of this chapter.

The resulting disturbance to the normal biological activity of birds arises from the different levels of response (Fox and Madsen 1997), either to individual birds or to groups of birds. As stated by Fox and Madsen (1997), birds may experience minor disruptions from normal activity (e.g. walking or swimming away) or be displaced from an optimal distribution in their habitat. In a study of shorebirds in the Dutch Wadden Sea, a motor boat travelling at approximately 6m/h caused birds to walk away at a distance of approximately 300 feet, and stop feeding or fly away at approximately 150 feet (Smit and Visser 1993).This disruption results in extra energy expenditure, compounded by factors such as lost foraging or resting time and the additional energy spent in flight from disturbance (Fox and Madsen 1997). Birds may also be forced to leave optimal feeding sites and choose alternative sites that are less plentiful (Fox and Madsen 1997), and repeated flushing of waterbirds can lead to avoidance of normal foraging and resting locations (Rodgers and Schwikert 2002).

Moreover, the negative effects of continued DBOC motorboat use on birds in Drakes Estero could increase as a result of rack repair associated with the issuance of a new SUP under alternative B. Under alternative B, DBOC would repair or replace 50 inactive-dilapidated racks in 2013 and repair and additional 25 active racks in 2014 (DBOC 2012b [xxxvi]). DBOC has not indicated whether rack repair would result in additional boat use in Drakes Estero. If additional motorboat use would be required to perform the repairs and maintenance, additional flushing and interruption of normal biological activity would be expected to negatively affect a small portion of birds in the project area, causing short-term minor adverse impacts to birds and bird habitat.

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. DBOC's pneumatic drills are estimated to produce sound levels between 67 and 80 dBA at 50 feet. Use of drills at these levels could take between 0.4 miles (2,071 feet) and 1.4 miles (7,537 feet) for the noise to decrease to the ambient sounds level (34 dBA). Detail related to soundscapes is provided in the "Impacts on Soundscapes" section of this chapter.

The diversity and population of many bird species can be altered 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). Under alternative B, 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 in Drakes Estero associated with continued operation of DBOC, 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 in Drakes Estero with lower-frequency and/or lower-amplitude calls may be more adversely affected by sounds from DBOC motorboats and operations. These types of sounds can mask or distort the natural sounds in the environment and affect predator-prey relationships (Ortega 2012). For instance, predation risk for some birds increases in areas with high-amplitude, low-frequency mechanical sounds (Lima 2009), such as DBOC motorboats and pneumatic equipment discussed above. Risk of predation related to DBOC operations would continue under alternative B because birds would have a reduced ability to detect auditory cues made by the predators (such as a red-tailed hawk scream or the cawing of a crow), and/or 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). As a result, birds in Drakes Estero may experience an increase in direct mortality from predators, or choose to avoid risk-prone habitat despite other potential habitat benefits related to resting and foraging availability.

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 in Drakes Estero would result in readily apparent effects on populations, natural processes, and bird habitat in the project area.

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 in 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 in Drakes Estero for an additional 10 years. As described above, the impacts of alternative B on birds would result in readily apparent effects on bird populations, natural processes, and habitat in the project area. Because of Drakes Estero's importance to regional shorebird and Pacific black brant conservation, the failure to protect these species from disturbances related to shellfish operations, especially during spring migration, could result in long-term adverse impacts. Shellfish racks would remain as artificial features in Drakes Estero, and could continue to provide food sources and resting structure for some bird species. Assuming that birds would have a limited exposure to commercial shellfish operation-related debris pollution, adverse impacts on birds from the ingestion of small debris fragments would be minimal because the impacts would be slightly detectable and would affect only a small segment of the populations, their natural processes, or habitat in the project area. The continued use of motorboats and other noise-producing equipment, as well as the continued maintenance of shellfish growing structures in Drakes Estero, would continue to disrupt biological activities 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. This would include additional short-term minor adverse impacts on birds associated with shellfish rack repairs outside the harbor seal pupping season in 2013 and 2014. The cumulative impact would be long term, moderate, and 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" and "participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d). Alternative B would not be consistent with NPS policies to preserve and restore natural abundances, dynamics, distributions, habitats, and behaviors of native bird populations, and to participate in regional protection. Specifically, NPS would not be meeting its responsibilities to the Pacific Flyway Management Plan for Brant or the Southern Pacific Shorebird Conservation Plan. Alternative B would not be consistent with the NPS commitment to Executive Order 13186 which directs agencies to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. Further, alternative B would also not be consistent with the NPS MOU with USFWS, according to which the NPS must incorporate bird conservation measures into agency actions and planning processes. Actions under alternative B would be consistent with the MBTA (16 USC 703–712, as amended), which makes it illegal to "take" migratory birds or their eggs, feathers, or nests.

As described in Hickey et al. (2003) and other bird conservation plans, because of allowing human activity (including kayaking and shellfish operations) and continuing alteration of tidal habitat, alternative B would

not be expected to support the recommended habitat goal of increasing the extent and quality of tidal flats for shorebirds (Hickey el al. 2003). Alternative B would not be expected to support the primary regional conservation goal of the U.S. Shorebird Conservation Plan to maintain the quality and quantity of habitat at local levels in order to support birds that breed, winter in, and migrate through each region (Brown et al. 2001). As such, DBOC shellfish operations under alternative B would be expected to adversely affect birds and bird habitat by not adhering to conservation strategies outlined in bird conservation plans.

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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact birds would be the same as those 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 cultivation beds 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 not expected to result in any difference in impacts between the two alternatives.

Impacts associated with DBOC operations and facilities under alternative C would be associated with disturbances of birds from continued DBOC operations in Drakes Estero and the displacement of habitat associated with the continued use of racks and bags for shellfish cultivation. Assuming that birds would have a limited exposure to mariculture debris pollution, adverse impacts to birds from ingestion of small debris fragments would be slightly detectable and would not affect the overall structure of any natural community. These impacts would be expected to be the same those 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 disturbances from DBOC motorboats and the displacement of natural habitat by shellfish racks and bags in Drakes Estero would result in readily apparent effects on bird populations, natural processes, and bird habitat in the project area.

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 in 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 and associated human activities in Drakes Estero for an additional 10 years. The impacts of alternative C on birds would result in readily apparent effects on bird populations, natural processes, and habitat in the project area. Because of Drakes Estero's importance to regional shorebird and Pacific black brant conservation, the failure to protect these species from disturbances related to shellfish operations, especially during spring migration, could result in long-term adverse impacts. Shellfish racks would remain as artificial features in Drakes Estero and could continue to provide food sources and resting structure for some bird species. Assuming that birds would have a limited exposure to commercial shellfish operation-related debris pollution, adverse impacts on birds from the ingestion of small debris fragments would be minor because the impacts would be slightly detectable and would affect only a small segment of the populations, their natural processes, or habitat in the project area. The continued use of motorboats and other noise-producing equipment, as well as the continued maintenance of shellfish growing structures, in Drakes Estero would continue to disrupt biological activities 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. This would include additional short-term minor adverse impacts on birds associated with shellfish rack repairs outside the harbor seal pupping season in 2013 and 2014. The cumulative impact would be long term, moderate, and 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" and "participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d). Alternative C would not be consistent with NPS policies to preserve and restore natural abundances, dynamics, distributions, habitats, and behaviors of native bird populations, and to participate in regional protection. Specifically, NPS would not be meeting its responsibilities to the Pacific Flyway Management Plan for Brant or the Southern Pacific Shorebird Conservation Plan. Alternative C would not be consistent with the NPS commitment to Executive Order 13186, which directs agencies to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. Further, alternative C would also not be consistent with the NPS MOU with USFWS, according to which the NPS must incorporate bird conservation measures into agency actions and planning processes.

Actions under alternative C would be consistent with the MBTA (16 USC 703–712, as amended), which makes it illegal to "take" migratory birds or their eggs, feathers, or nests.

As described in Hickey et al. (2003) and other bird conservation plans, because of allowing human activity (including kayaking and shellfish operations) and continued alteration of tidal habitat, alternative C would not be expected to support the recommended habitat goal of increasing the extent and quality of tidal flats for shorebirds (Hickey el al. 2003). Alternative C would not be expected to support the primary regional conservation goal of the U.S. Shorebird Conservation Plan to maintain the quality and quantity of habitat at local levels in order to support birds that breed, winter in, and migrate through each region (Brown et al. 2001). As such, DBOC shellfish operations under alternative C would be expected to adversely affect birds and bird habitat by not adhering to conservation strategies outlined in bird conservation plans.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Under alternative D, similar to alternatives B and C, NPS would issue a new SUP to DBOC for a period of 10 years for commercial shellfish operations in 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 could result in impacts greater than those expected under alternatives B and C, although the degree of difference is unable to be determined. Assuming that birds would have a limited exposure to commercial shellfish operation-related debris pollution, adverse impacts to birds from ingestion of small debris fragments would be minor because they would be slightly detectable and would only affect a small segment of the populations, their natural processes, or habitat in the project area. 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 in Drakes Estero would result in readily apparent effects on bird populations, natural processes, and bird habitat in the project area.

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 in 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 and the associated human activities in Drakes Estero for an additional 10 years. The adverse impacts could be incrementally greater under this alternative than under alternatives B and C due to the potential for increased motorboat activities. Because of Drakes Estero's importance to regional shorebird and Pacific black brant conservation, the failure to protect these species from disturbances related to shellfish operations, especially during spring migration, could result in long-term adverse impacts. Shellfish racks would remain as artificial features in Drakes Estero, and could continue to provide food sources and resting structure for some bird species. Assuming that birds would have a limited exposure to commercial shellfish operation-related debris pollution, adverse impacts on birds from the ingestion of small debris fragments would be minor because the impacts would be slightly detectable and would affect only a small segment of the populations, their natural processes, or habitat in the project area. The continued use of motorboats and other noise-producing equipment, as well as the continued maintenance of shellfish growing structures, in Drakes Estero would continue to disrupt biological activities 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. This would include additional short-term minor adverse impacts on birds associated with shellfish rack repairs outside the harbor seal pupping season in 2013 and 2014. The impacts of alternative D on birds would result in readily apparent effects on bird populations, natural processes, and habitat in 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" and "participate in local and regional scientific and planning efforts, identify ranges of populations of native plants and animals, and develop cooperative strategies for maintaining or restoring these populations in the parks" (NPS 2006d). Alternative D would not be consistent with NPS policies to preserve and restore natural abundances, dynamics, distributions, habitats, and behaviors of native bird populations, and to participate in regional protection. Specifically, NPS would not be meeting its responsibilities to the Pacific Flyway Management Plan for Brant or the Southern Pacific Shorebird Conservation Plan. Alternative D would not be consistent with the NPS commitment to Executive Order 13186, which directs agencies to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. Further, alternative D would also not be consistent with the NPS MOU with USFWS, according to which the NPS must incorporate bird conservation measures into agency actions and planning processes. Actions under alternative D are consistent with the MBTA (16 U.S.C. 703–712, as amended), which makes it illegal to "take" migratory birds or their eggs, feathers, or nests.

As described in Hickey et al. (2003) and other bird conservation plans, by allowing human activity (including kayaking and shellfish operations) and continued alteration of tidal habitat, alternative D would not be expected to support the recommended habitat goal of increasing the extent and quality of tidal flats for shorebirds (Hickey el al. 2003). Alternative D would not be expected to support the primary regional conservation goal of the U.S. Shorebird Conservation Plan to maintain the quality and quantity of habitat at local levels in order to support birds that breed, winter in, and migrate through each region (Brown et al. 2001). As such, DBOC shellfish operations under alternative D would be expected to adversely affect birds and bird habitat by not adhering to conservation strategies outlined in bird conservation plans.

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 ROD 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 to obtain a list of threatened and endangered species and designated critical habitats that may occur in the project area. Information on possible threatened or endangered species, candidate species, and species of special concern was also gathered by NPS from past studies and plans. NPS determined that none of the federally listed plant species in the USFWS results have potential to be affected by the proposed actions in the project area. Further, NPS determined that seven of the federally listed animal species have potential to exist in the project area. As described in chapter 1, five of the federally listed animal species were dismissed from further analysis in the EIS due to a lack of designated critical habitat in the project/action area, unconfirmed presence of the species in the project/action area, or the potential for less than minor impacts on the species and/or their critical habitat. These include Myrtle's silverspot butterfly, California red-legged frog, leatherback sea turtle, western snowy plover, and California least tern. As such, this section summarizes the impacts on two federally listed animal species or their designated critical habitat from the actions that would potentially occur under each alternative. These species include central California Coho salmon and central California steelhead. In the case that animal species are not known to use the designated critical habitat in the project area, the discussion is focused on potential impacts on that habitat (not the animal).

Information used to complete the impact analysis was gathered from multiple sources, including NMFS and USFWS consultations on record for previous Seashore projects (NMFS 2006, 2009, 2011g; USFWS 2004, 2008), scientific literature pertaining to the central California Coho salmon and steelhead, and from federal documents pertaining to ESA protection for each species. No studies of central California Coho salmon and central California steelhead have been conducted in Drakes Estero; however, studies in the region in similar settings and government agency management plans provided suitable background information for the analysis of impacts.

Some information used for analysis in this section is described in federal documents pertaining to ESA protection of Coho salmon and steelhead. These documents include notices published in the U.S. Federal Register such as final rules and executive orders. They also include recovery plans required by the ESA, which are guidance documents intended to delineate reasonable actions that are believed to be required to recover and/or protect listed species. As such, according to the ESA, the recovery plans must at a minimum provide a description of site-specific management actions necessary to achieve recovery of a species; objective, measurable criteria which, once met, would result in a determination that the species be removed from the list; and estimates of the time and cost required to achieve the plan's goal (NMFS 2010d). A 5-year review is also required to evaluate whether or not a species status has changed since it was listed or since the last 5-year review.

NMFS recovery planning follows NMFS interim recovery planning guidance, which was established in July 2006. This guidance, in addition to status reviews conducted by NMFS, has led to several recent recovery documents for salmon and steelhead species in multiple regions. Recovery of the central California coast Coho salmon is outlined in the draft central California coast Coho salmon recovery plan

(NMFS 2010b), which is in the approval process. Recovery of the central California coast Steelhead is described in the *Federal Recovery Outline for the Distinct Population Segment of Central California Coast Steelhead* (NMFS 2011e). This is a NMFS pre-planning document to facilitate development of a draft recovery plan. The detailed information on central California coast Coho salmon critical habitat and the central California coast steelhead presented in these documents was used in the impact analysis for this section. In order to meet ESA requirements, site-specific and species-specific information presented in recovery documents is based on the most recent and relative research from the scientific community.

In consideration of the federally listed animal species or their designated critical habitat discussed in chapter 3, impacts these federally protected resources 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

Negligible: The impact is not detectable or measurable.

Minor: Impacts on federally listed individuals or populations would be slightly detectable in the project area. Impacts on critical habitat would be slightly detectable and localized (affecting a small portion of the designated critical habitat in the project area).

Moderate: Impacts on federally listed individuals or populations would be readily apparent in the project area. Impacts on designated critical habitat in the project area would be readily apparent.

Major: Impacts on federally listed individuals or populations would be readily apparent, widespread, and may result in the loss of the federally listed species. Impacts on designated critical habitat would be readily apparent and widespread and may result in the loss of designated critical habitat.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations would expire on November 30, 2012. As described in chapter 2, DBOC operations would cease, and DBOC would be responsible for the removal of certain buildings and structures and all personal property. Based on information provided in chapter 3, impacts of alternative A on the federally listed Central California coho salmon critical habitat and Central California steelhead are discussed below.

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 in) estuaries during their migration (CDFG 2004c). Typically, juveniles use estuaries as rearing and nursery habitat, while adults use estuaries as a holding area used to prepare for migration upstream (CDFG 2004c). While Coho salmon are not currently found in the Drakes Estero watershed, recovery potential related to

repopulation is possible in Drakes Estero due to the presence of various critical habitat requirements, such as space for individuals and population growth, nutritional and physiological requirements, cover and shelter from predators, and rearing habitat for offspring, among others (NOAA 1999). Further, nomadic juvenile Coho salmon (i.e. those that stray from their natal habitat) from nearby populations could swim into the Drakes Estero to seek rearing or refuge habitat (Koski 2009, Roni et al. 2012).

Disturbance from mariculture operations in Drakes Estero can affect the critical habitat requirements for Coho salmon. For example, damage to eelgrass beds from motorboat propellers and oyster racks can adversely impact eelgrass habitat (see the "Impacts on Wildlife and Wildlife Habitat: Fish" section of this chapter), which in turn alters the natural role of eelgrass as refuge and rearing habitat for Coho salmon. In addition, offshore structures are subject to deterioration and damage by weather events, and debris from damaged mariculture infrastructure can become dislodged and degrade Coho salmon habitat. Therefore, alternative A would improve the quality of Coho salmon critical habitat requirements by eliminating disturbance from mariculture operations in Drakes Estero.

Removal of racks during DBOC closeout procedures would remove lumber treated with wood preservatives from Drakes Estero. However, the wooden structures in Drakes Estero have been in contact with water for years and are not expected to continue the release of copper leachates into the aquatic environment. Therefore, the removal of treated lumber under alternative A would eliminate artificial shellfish structures from Drakes Estero and improve critical habitat for the central California Coho salmon by returning eelgrass habitat to more natural conditions. The removal of treated lumber is not anticipated to negatively affect water quality in the critical habitat through the release of wood preservative leachates.

As mentioned in the discussion of impacts on eelgrass, removal of the racks from in Drakes Estero during DBOC closeout procedures could cause temporary adverse impacts to eelgrass 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. Rack removal would be conducted using standard BMPs to minimize sediment disturbance.

Overall, Alternative A would result in long-term beneficial impact on central California Coho salmon critical habitat as a result of improving designated critical habitat.

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 though 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 in 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 eelgrass habitat functions provided to the steelhead, such as refuge from predation.

The role of Drakes Estero as nursery habitat for fish to feed, spawn, and avoid predators (Wechsler 2004[xxxvii]) is also an important aspect that likely benefits the central California steelhead. Studies have shown that estuaries are essential to juvenile steelhead by providing valuable rearing and nursery habitat (Bond 2006). Steelhead do not spawn in estuaries, but juveniles rely on estuary habitat to forage and

avoid predators so that they can mature and complete their anadromous life cycle (Bond 2006). Studies from similar estuaries to Drakes Estero suggest that eelgrass may not be a requisite habitat element for rearing steelhead, and that steelhead prey are not unique to eelgrass. The diet of juvenile steelhead that are reared in similar settings to Drakes Estero can include fairly common prey species such as amphipods and isopods (Bond 2006). While some steelhead prey species are found in eelgrass beds, they also utilize other habitat like those found in unvegetated estuarine environments.

Under this alternative, the restoration of natural eelgrass habitat by eliminating motorboat travel and oyster racks from Drakes Estero (see the "Impacts on Eelgrass" section for additional detail) would be expected to improve the quality of rearing and nursery habitat for central California steelhead. The effect of commercial shellfish operations on eelgrass habitat, such as fragmentation of the habitat from propeller scars, can cause non-natural spatial redistribution of steelhead prey species (Bostrom, Jackson, and Simenstad 2006). Because this redistribution of prey species could also affect the natural foraging habits of steelhead, this alternative would be expected to restore natural foraging behavior and habitat of steelhead by restoring the natural distribution of their prey in eelgrass habitat.

The removal of shellfish racks used in the commercial shellfish operations in Drakes Estero could also benefit central California steelhead. Studies have shown that shading, changes in wave energy, and substrate alteration caused by overwater structures can affect juvenile steelhead during migration through estuaries (Nightengale and Simenstad 2001). The effect on steelhead is related to the changes the overwater structure cause to prey species distribution. For instance, the distribution of invertebrates under overwater structures has been found to be different than that found in adjacent non-shaded vegetated habitats (Nightengale and Simenstad 2001). Therefore, due to the removal of shellfish racks this alternative would be expected to restore the natural distribution of steelhead prey in Drakes Estero, which would be expected to further restore the natural foraging behavior and habitat of central California steelhead.

As discussed the "Impacts to Eelgrass" section of this chapter, removal of the racks from in Drakes Estero during DBOC closeout procedures could result in temporary adverse impacts to eelgrass, but would improve the overall quality of eelgrass habitat. Rack removal would be conducted using standard BMPs to minimize disturbances, and would remove lumber treated with wood preservatives from Drakes Estero. However, the wooden structures in Drakes Estero have been in contact with water for years and are not expected to continue the release of copper leachates into the aquatic environment. Therefore, the removal of treated lumber under alternative A would eliminate artificial shellfish structures from Drakes Estero and improve habitat for the central California steelhead by returning eelgrass habitat to more natural conditions. The removal of treated lumber is not anticipated to negatively affect water quality through the release of wood preservative leachates in the steelhead habitat.

Offshore structures are subject to deterioration and damage by weather events which may result in dispersal of items such as Styrofoam floats, treated lumber displaced from racks, and PVC piping and separators. Marine debris from damaged mariculture infrastructure has become dislodged and found floating in Drakes Estero or washed up on mudflats and shorelines. Under this alternative, all racks and bags would be removed, and central California steelhead habitat in Drakes Estero would be enhanced by eliminating the potential for mariculture debris pollution in the aquatic environment.

Alternative A would result in long-term beneficial impacts to central California steelhead by eliminating impacts on eelgrass caused by DBOC boats, reducing exposure to mariculture debris pollution, and returning eelgrass habitat to a more natural condition by removing artificial shellfish structures. Alternative A could result in short-term adverse impacts on the central California steelhead because of localized sedimentation in habitat during close out procedures would be slightly detectable for a period of 2 to 3 months.

Overall, alternative A would result in long-term beneficial impacts on central California Coho salmon critical habitat and the central California steelhead in the project area. Alternative A could also result in short-term minor adverse impacts to these protected resources during removal of DBOC facilities and personal property because removal could disturb individuals or cause temporary sedimentation in designated critical habitat. However, the short-term impacts related to removal would be highly localized and would last 2 to 3 months.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact central California Coho salmon critical habitat and the central California steelhead in the project area. These actions include planning and management activities, coastal watershed restoration projects (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), and the CDFG MLPA initiative. Recent coastal watershed restoration efforts in 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 central California Coho salmon critical habitat and central California steelhead by improving fish migration opportunities in the project area and the larger watershed.

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

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 central California Coho salmon critical habitat and the central California steelhead. Alternative A would contribute a noticeable beneficial increment to the overall cumulative impact.

Conclusion

Overall, alternative A would result in a long-term beneficial impact on central California Coho salmon critical habitat and the central California steelhead. Alternative A could also result in short-term minor adverse impacts on these federally protected resources during the removal of DBOC facilities and personal property because these activities could disturb individuals or cause temporary sedimentation in designated critical habitat. The short-term impacts related to removal would be highly localized and

would last for a period of two to three months. The cumulative impact would be long term and beneficial, and alternative A would contribute a noticeable beneficial increment to the overall cumulative impact.

For central California Coho salmon critical habitat and the central California steelhead, 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 to ensure that the proposed 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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact central California Coho salmon critical habitat or the central California steelhead include:

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

Central California Coho Salmon Critical Habitat. The Coho salmon 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, and 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). The diverse estuarine habitats in Drakes Estero provide many of these critical habitat requirements for Coho Salmon, such as space for individual and population growth, nutritional and physiological requirements, cover from predators, and sites for rearing of offspring. The quality of some critical habitat requirements could potentially be affected by this alternative, including food or nutritional requirements, cover from predators, and site for rearing of offspring.

The displacement of eelgrass from propeller scars and oyster racks (see "Impacts to Eelgrass" section of this chapter) would be expected to cause adverse impacts to Coho salmon critical habitat by reducing the quality of some critical habitat requirements. Eelgrass beds serve as habitat for Coho salmon prey species and provide cover for predator avoidance (PFMC 2003). In studies of estuarine habitats where Coho salmon are normally present, the salmon have been captured in relatively high abundances in samples taken from eelgrass habitat (Harris et al. 2008). As described in the "Impacts to Wildlife and Wildlife Habitat: Fish" section of this chapter, impacts to eelgrass from DBOC shellfish operations can create localized non-natural fish distributions that affect the functionality of fish habitat. Changes in fish distributions could affect the natural predator-prey relationships pertaining to Coho salmon by altering their prey availability and/or predator abundance. Therefore, impacts to eelgrass habitat could create local adverse impacts to Coho salmon critical habitat by altering food and cover requirements.

While Coho salmon are not currently present in Drakes Estero, the protection of their designated critical habitat provides greater potential for salmon to repopulate Drakes Estero. As stated above, critical habitat requires sites for rearing of offspring (NOAA 1999). Drakes Estero provides potential habitat for the rearing of offspring because nomadic juvenile Coho salmon can use estuaries adjacent to their natal waters for additional rearing habitat (Koski 2009; Roni et al. 2012). Therefore, the known Coho salmon populations from adjacent watersheds in Marin County and Sonoma County (King 2004) could provide a source of nomadic juvenile Coho which could potentially occupy Drakes Estero. Impacts to eelgrass habitat could also adversely impact Coho salmon critical habitat by altering sites for rearing of offspring. However, impacts would be localized because Drakes Estero has other habitat types that could be used for rearing of offspring.

Under the assumption that limited incidental mariculture debris pollution would continue under alternative B, adverse impact to Coho salmon critical habitat could result from the presence of small fragments of synthetic debris in Drakes Estero. While Coho salmon do not currently reside in Drakes Estero, the presence of synthetic debris could impact critical habitat by altering their food source. If nomadic juvenile Coho were to enter Drakes Estero, debris could be mistaken as food and could alter their digestion, injure the stomach, or provide of a potential source of toxic material (Laist 1987). Therefore, mariculture debris pollution could adversely impact Coho salmon critical habitat by altering food requirements.

As described in DBOC's November 2010 submittal to NPS, 50 racks in Drakes Estero are categorized by DBOC as "Needs repair Inactive." Should a new SUP be issued, DBOC's June 5, 2012 request is to repair plans to repair 50 of the racks in 2013 and another 25 racks in 2014 (DBOC 2012b[xxxviii]). It is assumed that the 50 racks in 2013 represent the 50 racks categorized in 2010 as "Needs repair inactive". The 50 racks to be replaced in 2013 represent a total length of approximately 13, 608 feet covering 3.75 acres. Assuming that 50 to 75 percent of the materials in the existing racks need to be replaced, the 2013 repairs would require installation of between 65,000 and 97,000 linear feet of lumber. It is anticipated that between 1,700 and 2,500 vertical 2-inch by 6-inch posts would be installed into the bottom of Drakes Estero.

In 2014, 25 racks would be repaired or replaced. This represents approximately half of the total racks classified as "Good Order and Condition Active" according to DBOC's 2010 submittal to NPS, referenced above. It is anticipated that the total length of racks treated in 2014 would be approximately 6,030 feet (1.66 acres). Based on the good order and condition, it is anticipated that between 25 percent and 50 percent of the materials would need to be replaced. The 2014 repairs would require installation of between 14,000 and 29,000 linear feet of lumber and between 380 and 750 vertical 2-inch by 6-inch posts.

DBOC has not indicated whether the rack repairs proposed under alternative B would result in additional boat use in Drakes Estero. Posts installed during rack repair into the bottom of Drakes Estero would disturb the underlying substrate, leading to localized sedimentation in critical habitat. Standard sediment control BMPs would be implemented to reduce sediment erosion into neighboring wetlands or other waters, thereby reducing potential water quality impacts that could adversely affect Coho salmon critical habitat requirements. The posts and other treated wood could adversely impact water quality, resulting from the release of copper leachates from pressure treated lumber. Since the olfactory sensory capability of Coho salmon can be damaged when copper concentrations rise by 0.79 ug/L above ambient conditions (NOAA 2009), alternative B has additional potential to negatively affect water quality and Coho salmon critical habitat. However, based on regulatory permit conditions that would likely be associated with rack

repair activity, this assessment assumes that lumber used for rack repair would require an approved coating material in order to minimize the potential for release of copper leachates from treated wood into aquatic environments.

As a result, due localized sedimentation for a period of 2 to 3 months, the impacts to water quality in Coho salmon critical habitat associated with rack repair and/or replacement under alternative B would be slightly detectable in the project area. Adverse impacts related to localized sedimentation would also be expected to result from DBOC cleanup procedures should workers disturb the soft bottom of Drakes Estero when retrieving loose debris from intertidal mudflats; however, these impacts are not expected to cause a noticeable increase in sedimentation to the ongoing impacts related to general shellfish operation activities.

Therefore, alternative B would result in long-term minor impacts on central California Coho salmon designated critical habitat for an additional 10 years because continued damage to eelgrass and water quality would be slightly detectable and localized, and could degrade a relatively small proportion of designated critical habitat requirements in the project area.

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). While Drakes Estero is not part of the steelhead's designated critical habitat area, the role Drakes Estero provides as nursery habitat for fish to feed, spawn, and avoid predators (Wechsler 2004[xxxix]) is also an important aspect that likely benefits the central California steelhead. Estuaries like Drakes Estero are essential to juvenile steelhead and provide valuable rearing and nursery habitat, allowing juveniles to forage and avoid predators so that they can mature and complete their anadromous life cycle (Bond 2006).

Under this alternative, the displacement and damage to eelgrass habitat from DBOC motorboat propeller scars and oyster racks (see the "Impacts on Eelgrass" section for additional detail) would be expected to affect the quality of rearing and nursery habitat for central California steelhead. Fragmentation of the habitat from propeller scars can cause non-natural spatial redistribution of steelhead prey species (Bostrom, Jackson, and Simenstad 2006). Therefore, this alternative could have localized adverse impacts on steelhead foraging success by altering the natural distribution of their prey in eelgrass habitat. However, studies show that eelgrass may not be a requisite habitat element for rearing steelhead, and that the diet of juvenile steelhead can include fairly common prey species such as amphipods and isopods (Bond 2006). While some steelhead prey species are found in eelgrass beds, they also utilize other habitat like those found in unvegetated estuarine environments.

The continued use of racks for commercial shellfish operations in Drakes Estero could also affect central California steelhead. Overwater structures can create non-natural light infiltration from shading, and cause changes in wave energy and bottom substrates that can affect juvenile steelhead behavior during migration through estuaries (Nightengale and Simenstad 2001). The effect on steelhead is related to the changes the overwater structure cause to prey species distribution. For instance, the distribution of invertebrates under overwater structures has been found to be different than that found in adjacent non-shaded vegetated habitats (Nightengale and Simenstad 2001). Therefore, due to the potential effects of shellfish racks in Drakes Estero as overwater structures, this alternative would be expected to create a non-natural distribution of steelhead prey near the racks, which would be expected to have localized adverse impacts on the natural foraging behavior and habitat of central California steelhead.

The impacts of installing additional racks using pressure treated lumber to the central California steelhead would be expected to be similar to those described for Coho salmon. Posts installed during rack repair into the bottom of Drakes Estero would disturb the underlying substrate, leading to localized sedimentation in critical habitat. However, standard sediment control BMPs would be implemented to reduce sediment erosion into neighboring wetlands or other waters.

The posts and other treated wood could adversely impact water quality, resulting from the release of copper leachates from pressure treated lumber. Similar to the Coho salmon, olfactory sensory capability of steelhead can be damaged when copper concentrations rise by 0.79 ug/L above ambient conditions (NOAA 2009). However, based on regulatory permit conditions that would likely be associated with rack repair activity, this assessment assumes that lumber used for rack repair would require an approved coating material in order to minimize the potential for release of copper leachates from treated wood into aquatic environments with salmonid habitat. As a result, due localized sedimentation for a period of 2 to 3 months, the impacts to central California steelhead associated with rack repair and/or replacement under alternative B would be slightly detectable in the project area and therefore be expected to be short-term and minor.

Under the assumption that limited incidental mariculture debris pollution would continue under alternative B, direct adverse impact to central California steelhead could result from the presence of small fragments of synthetic debris in Drakes Estero. This could occur through the ingestion of debris by steelhead, which could inhibit their digestion and remain in the stomach for long periods of time. This could affect the steelhead through a reduction in appetite, injury to the stomach, or by provision of a potential source of toxic material (Laist 1987). These effects from mariculture debris could adversely impact central California steelhead by decreasing energy or health that may make the fish more susceptible to predation, disease, and reduced breeding success (Laist 1987).

Adverse impacts to central California steelhead related to sedimentation would also be expected to result from DBOC cleanup procedures should workers disturb the soft bottom of Drakes Estero when retrieving loose debris from intertidal mudflats; however, these impacts are not expected to cause a noticeable increase in sedimentation to the ongoing impacts related to general shellfish operation activities.

Therefore, alternative B would result in long-term minor impacts on central California steelhead for an additional 10 years because ongoing direct and indirect impacts to a relatively small portion of steelhead and steelhead habitat would be slightly detectable and localized.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact central California Coho salmon critical habitat and central California steelhead in 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 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 central California Coho salmon

critical habitat and the central California steelhead. 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 central California Coho salmon critical habitat and the central California steelhead 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 central California Coho salmon critical habitat and the central California steelhead for an additional 10 years because impacts from ongoing DBOC operations would be slightly detectable and localized, and could disrupt a small proportion of the individuals and/or designated critical habitat in the project area. Damage to eelgrass habitat and changes in water quality have the potential to cause localized and slightly detectable adverse impacts on Coho salmon critical habitat by reducing the quality of some required habitat elements, such as food and cover requirements. The displacement of eelgrass from propeller scars and oyster racks, as well as the nonnatural changes to habitat condition from oyster racks, could cause a nonnatural redistribution of steelhead prey species that would be expected to have slightly detectable adverse impacts on the natural foraging behavior and habitat of central California steelhead. Alternative B would also result in short-term minor adverse impacts because activities associated with the repair and replacement of racks in 2013 and 2014 could cause localized sedimentation for a few months each year (outside of the seal pupping season) that would cause slightly detectable impacts to federally listed individuals or populations and critical habitat in the project area. The extent of these impacts on water quality would be minimized by using standard sediment control BMPs and an approved coated lumber, which would further decrease the impacts to federally listed individuals, populations, and critical habitat. Assuming that commercial shellfish operation-related debris pollution would be limited in Drakes Estero, adverse impacts to central California Coho salmon critical habitat and the central California steelhead from this debris would not affect the overall structure of any natural community. Cumulative impacts would be long term and beneficial, and alternative B would contribute a noticeable adverse increment to the overall cumulative impact.

For central California Coho salmon critical habitat and the central California steelhead, 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 would. NPS *Management Policies 2006* 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 would complete consultation with USFWS and/or NMFS 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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact central California Coho salmon critical habitat and the central California steelhead 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 this alternative, damage to eelgrass habitat and reduction in water quality have the potential to cause localized and slightly detectable adverse impacts to Coho salmon critical habitat by reducing the quality of some required habitat elements.. The displacement of eelgrass from propeller scars and oyster racks, as well as the non-natural changes to habitat condition from oyster racks, could cause a non-natural redistribution of steelhead prey species that would be expected to have slightly detectable adverse impacts on the natural foraging behavior and habitat of central California steelhead. Assuming that Drakes Estero would have a limited exposure to mariculture debris pollution, adverse impacts to central California Coho salmon critical habitat and the central California steelhead from mariculture debris would not affect the overall structure of any natural community.

Therefore, alternative C would result in long-term minor adverse impacts on central California Coho salmon critical habitat and the central California steelhead for an additional 10 years due to the continued operation of a commercial shellfish operation in Drakes Estero. Impacts on these federally listed species would be slightly detectable and impacts on the designated critical habitat in the project area would be slightly detectable and localized.

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 central California Coho salmon critical habitat and the central California steelhead. Impacts on these federally protected resources 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 central California Coho salmon critical habitat and the central California steelhead in 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 planning and management activities, coastal watershed restoration projects (Geomorphic 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 central California Coho salmon critical habitat and the central California steelhead. 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 central California Coho salmon critical habitat and the central California steelhead 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 central California Coho salmon critical habitat and the central California steelhead for an additional 10 years because impacts from ongoing DBOC operations would be slightly detectable and localized, and could disrupt individuals and/or designated critical habitat in the project area. Damage to eelgrass habitat and changes in water quality have the potential to cause localized and slightly detectable adverse impacts to Coho salmon critical habitat by reducing the quality of some required habitat elements, such as food and cover requirements. The displacement of eelgrass from propeller scars and oyster racks, as well as the nonnatural changes to habitat condition from oyster racks, could cause a nonnatural redistribution of steelhead prey species that would be expected to have slightly detectable adverse impacts on the natural foraging behavior and habitat of central California steelhead. Alternative C would also result in short-term minor adverse impacts because activities associated with the repair and replacement of racks in 2013 and 2014 could cause localized sedimentation for a period of two to three months per year that would be slightly detectable in the project area. The extent of these impacts on water quality would be minimized by using standard sediment control BMPs and an approved coated lumber, which would further decrease the impacts to federally listed individuals, populations, and critical habitat. Assuming that commercial shellfish operation-related debris pollution is limited in Drakes Estero, adverse impacts to central California Coho salmon critical habitat and the central California steelhead from this debris would not affect the overall structure of any natural community. Cumulative impacts would be long term and beneficial, and alternative C would contribute a noticeable adverse increment to the overall cumulative impact.

For central California Coho salmon critical habitat and the central California steelhead, 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 would. NPS *Management Policies 2006* 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 would complete consultation with USFWS and/or NMFS 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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact central California Coho salmon critical habitat and the central California steelhead are the same as described under alternative B, with a few exceptions. Differences from alternative B that have the potential to impact these federally protected resources include:

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

Under alternative D, DBOC could produce up to 850,000 pounds of shellfish. 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 in DBOC offshore operations, including the presence/use of additional racks, bags, and other materials associated with commercial shellfish operations in the 138 acres of delineated culture beds. Increased operations could also cause expanded motorboat use/traffic.

As a result, adverse impacts associated with alternative D would likely be slightly greater than those described for alternatives B and C. Damage to eelgrass habitat and changes in water quality have the potential to cause localized and slightly detectable adverse impacts to Coho salmon critical habitat by reducing the quality of some required habitat elements, such as food and cover requirements. The displacement of eelgrass from propeller scars and oyster racks, as well as the non-natural changes to habitat condition from oyster racks, could cause a non-natural redistribution of steelhead prey species that would be expected to have slightly detectable and localized adverse impacts on the natural foraging behavior and habitat of central California steelhead. Assuming that Drakes Estero would have a limited exposure to commercial shellfish operation-related debris pollution, adverse impacts to central California Coho salmon critical habitat and the central California steelhead from this debris would not affect the overall structure of any natural community. However, although impacts on the offshore resources in Drakes Estero may be greater under this alternative than under the other alternatives, the increased production is expected to result in continued long-term minor adverse impacts on central California Coho salmon critical habitat and the central California steelhead.

Therefore, alternative D would result in long-term minor adverse impacts on central California Coho salmon critical habitat and the central California steelhead for an additional 10 years due to the continued operation of a commercial shellfish operation in Drakes Estero. Impacts on these federally listed species would be slightly detectable and impacts on the designated critical habitat in the project area would be slightly detectable and localized.

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 central California Coho salmon critical habitat and the central

California steelhead. Impacts on these federally protected resources 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 central California Coho salmon critical habitat and the central California steelhead in 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 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 D, would result in a long-term beneficial cumulative impact on central California Coho salmon critical habitat and the central California steelhead. 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 central California Coho salmon critical habitat and the central California steelhead 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 designated central California Coho salmon critical habitat and the central California steelhead for an additional 10 years because impacts from ongoing DBOC operations would be slightly detectable and localized (affecting a small proportion of the designated Coho salmon critical habitat and steelhead in the project area). Damage to eelgrass habitat and reduction in water quality have the potential to cause localized and slightly detectable adverse impacts to Coho salmon critical habitat by reducing the quality of some required habitat elements. The displacement of eelgrass from propeller scars and oyster racks, as well as the nonnatural changes to habitat condition from oyster racks, could cause a nonnatural redistribution of steelhead prey species that would be expected to have slightly detectable adverse impacts on the natural foraging behavior and habitat of central California steelhead. Alternative D would also result in short-term minor adverse impacts because activities associated with the repair and replacement of racks could cause localized sedimentation for a few months each year during 2013 and 2014 (outside of the seal pupping season) that would be slightly detectable in the project area. The extent of these impacts on water quality would be minimized by using standard sediment control BMPs and an approved coated lumber, which would further decrease the impacts to federally listed individuals, populations, and critical habitat. Assuming that commercial shellfish operation debris pollution would be limited in Drakes Estero, adverse impacts to central California Coho salmon critical habitat and the central California steelhead from commercial shellfish operation debris would not affect the overall structure of any natural community. The cumulative impact would be long term and beneficial, and alternative D would contribute a noticeable adverse increment to the overall cumulative impact.

For central California Coho salmon critical habitat and the central California steelhead, 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 would. NPS *Management Policies 2006* 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 would complete consultation with USFWS and/or NMFS 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 DO 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 in the flood zone is to protect human health and the environment and prevent damage to property in the event of a catastrophic flood event. An analysis of accumulated data from FEMA, survey elevations collected at the onshore facilities, and witness accounts from DBOC was performed to estimate the range of the 100-year flood zone at Drakes Estero, as described in chapter 3. Drakes Estero (including the waters of Drakes Estero and the surrounding lands up to approximately 9.0 feet NAVD 1988) falls in 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 in the flood zone at Drakes Estero would require compliance with DO 77-2 and related state/federal laws. Marin County would review design plans for any proposed work in 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 in a regulatory floodplain. Only alternative D would include the construction of a new structure in the flood zone, requiring the need for a 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 to Drakes Estero was conducted for Bolinas Beach, approximately 17 miles south of the Seashore. At Bolinas Beach the 100-year flood elevation is 8.2 feet (NAVD-88). This elevation was compared to gauge and field survey data collected from a storm event in Drakes Estero that occurred on March 20, 2011. During this storm, much of DBOC's onshore facilities incurred flooding. Chapter 3 details the land survey and tidal gauge data used to estimate the elevation of inundation from a major storm surge and wave run-up. Based on the land survey at the onshore facilities and gauge data from the Point Reyes Light Station, for the purposes of this analysis, an elevation of 9.0 feet NAVD-88 was estimated as the flood zone elevation for Drakes Estero. The focus of flood zone impacts for each alternative is on the onshore operations and facilities that would be inundated during a flood event.

Impacts to the flood zone in terms of flood storage displacement were considered in the analysis. However, exact measurements of materials placed in Drakes Estero would change day to day as bags, trays, and anchors are removed and/or installed during the mariculture process. Similarly, precise dimensions of items at the onshore facilities such as buildings, trailers, vehicles, and shell piles necessary to measure water volume displacement from a flood event is unknown. Therefore, the methodology relies on a qualitative analysis in comparing alternatives based on predicted infrastructure needs as provided by DBOC, particularly at the onshore facilities.

The NPS Procedural Manual 77-2 requires that structures and facilities in 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 on 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 in 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.

Intensity Definitions

This section will evaluate the impacts to properties located in 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:

Negligible: The impact is not detectable or measurable.
Minor: Impacts on the ability of the coastal flood zone to absorb and store floodwaters or storm surge would be minimal and would not result in an increase in potential flood damage in the project area.
Moderate: Impacts on the ability of the coastal flood zone to absorb and store floodwaters or storm surge would be readily apparent and would result in increased potential for flood damage in the project area.
Major: Impacts on the ability of the coastal flood zone to absorb and store floodwaters or storm surge would be readily apparent and would result in increased potential for severe flood damage in the project area.

IMPACTS OF ALTERNATIVE A

Impact Analysis

Under alternative A, the existing authorizations for DBOC operations would 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 in 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 because risks associated with dislodged and damaged materials floating and washing ashore during a flood event would be eliminated. The removal of materials that have the potential to adversely affect water quality if spilled during a flood event, such as stored fuels, paints, etc. would also be beneficial. The DBOC wastewater storage vaults would be pumped and sealed in place.

Under this alternative, certain buildings and structures, other personal property, and shell piles would be removed resulting in long term beneficial impacts to the coastal flood zone. Removal of these items would result in an increase of flood zone storage capacity equal to the volume of the items removed. Given the size of the estuary and its watershed (approximately 31 square miles), this increase would be highly localized.

Based on this information, alternative A would result in a long-term beneficial impact on coastal flood zones in the project area.

Cumulative Impact Analysis

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

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 in the project area. Additionally, moving the NPS vault toilet 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 in the project area.

Based on the information above, the impacts of these past, present, and reasonably foreseeable future actions, combined with the beneficial impacts of alternative A, would result in a long-term beneficial cumulative impacts 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 the flood storage capacity of the onshore area and the removal of structures and materials that have the potential to become dislodged and spread into habitat buffer areas, such as tidal vegetated wetlands and shorelines, during a flood event. The cumulative impact would be long term and beneficial, and alternative A would contribute a noticeable beneficial increment to the cumulative impacts.

With respect to coastal flood zones, alternative A would be consistent with relevant law and policy. The removal of structures and residences in the flood zone would fulfill the goals set forth by Executive Order 11988, "Floodplain Management" and the subsequent NPS DO 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 in 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 in 138 acres of Drakes Estero would remain in the coastal flood zone under this alternative. As part of DBOC's plan to refurbish existing racks, this alternative calls for the installation/replacement of between 1,700 and 2,500 2-inch by 6-inch rack posts in year 2013 and 380 to 750 rack posts in 2014 (DBOC 2012b[xl]). These offshore structures and materials could be damaged and/or dislodged during a flood event, potentially causing damage to resources in Drakes Estero. The loss of flood storage due to the racks and bags placed in Drakes Estero is minor and not likely to cause flooding of other properties.

Under this alternative DBOC would include replacement of the storm-damaged floating dock and conveyor system, a new washing collection system, and continued use of setting tanks, processing plant, stringing shed, shop, punching shed, and two mobile homes, which are all located in 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 in the coastal flood zone. The office/warehouse, main house, and cabin would also remain, although those structures and floor elevations would continue to 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 in 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 in 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 in 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 in the coastal flood zone.

Based on the information above, alternative B would have a long-term minor adverse impact on coastal flood zones in the project area for an additional 10 years. Continued DBOC infrastructure and buildings, although they would occur in the flood zone, would have minimal impact on the flood zone's ability to absorb and store floodwaters or storm surges and not result in an increase in the potential flood damage beyond what already exists. 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 in 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 NPS vault toilet landward of the flood zone, 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 minor adverse impacts of alternative B, would result in a long-term minor 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 minor adverse impacts on the coastal flood zone in the project area for an additional 10 years because continued DBOC operations would take place in the flood zone and would result in continued potential for flood damage to property and/or environmental contamination at the project site. However, these activities, and the associated infrastructure would have a minimal impact on the ability of the coastal flood zone to absorb and store floodwater or storm surge, and would not increase the potential for flood damage. Offshore structures and materials could be damaged and/or dislodged during a flood event, potentially causing damage to resources in 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 causing local contamination. Shell piles would reduce flood storage capacity in the area, whereas 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 untreated wastewater to enter Drakes Estero. The cumulative impact would be long term, minor, and adverse, and alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

NPS guidelines require that new actions in the flood zone comply with *Procedural Manual 77-2: Floodplain Management*. This alternative would allow the continued use of nonconforming structures and the replacement of storm damaged structures (dock and washing station) in the coastal flood zone. However, existing structures are grandfathered, and do not have to comply with Procedural Manual 77-2 guidelines. No new structures would be constructed under alternative B. 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 in 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. As part of DBOC's plan to refurbish existing racks, this alternative calls for the installation/replacement of between 1,700 and 2,500 2-inch by 6-inch rack posts in year 2013 and 380 to 750 rack posts in 2014. Impacts to offshore infrastructure 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. Onshore 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.

Based on the information above, alternative C would have a long-term minor adverse impact on coastal flood zones in the project area for an additional 10 years. Continued DBOC infrastructure and buildings, although they would occur in the flood zone, would have minimal impact on the flood zone's ability to absorb and store floodwaters or storm surges and not result in an increase in the potential flood damage beyond what already exists. 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 in 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 NPS vault toilet landward of the flood zone. 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 minor adverse impacts of alternative C, would result in a long-term minor 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 minor adverse impacts on the coastal flood zone in the project area for an additional 10 years because continued DBOC operations would take place in the flood zone and would result in continued potential for flood damage to property and/or environmental contamination at the project site. However, these activities and the associated infrastructure would have a minimal impact on the ability of the coastal flood zone to absorb and store floodwater or storm surge, and

would not increase the potential for flood damage. Offshore structures and materials could be damaged and/or dislodged during a flood event, potentially causing damage to resources in Drakes Estero. At the onshore facility, 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 causing local contamination. Shell piles would reduce flood storage capacity in the area, whereas 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 untreated wastewater to enter Drakes Estero. The cumulative impact would be long term, minor, and adverse, and alternative C would contribute an appreciable adverse increment to the cumulative impact.

NPS guidelines require that new actions in the flood zone comply with NPS *Procedural Manual 77-2: Floodplain Management*. This alternative would allow the continued use of nonconforming structures and the replacement of storm damaged structures (dock and washing station) in the coastal flood zone. However, existing structures are grandfathered, and do not have to comply with Procedural Manual 77-2 guidelines. No new structures would be constructed under alternative C. 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 in 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 limits
- Replacement of the existing onshore processing plant building and storm damaged structures to include the dock and washing station.

Alternative D includes consideration of new development to replace existing onshore facilities and a 40 to 70 percent increase in production levels compared to alternatives B and C, respectively. 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. New development would require additional site planning and design considerations and would be evaluated under separate review. Any new development would be built in accordance with relevant standards, including local building codes. Impacts to costal flood zones resulting from the continuation of the shellfish operation for an additional 10 years under alternative D are described as follows.

As part of DBOC's plan to refurbish existing racks, this alternative calls for the installation/replacement of between 1,700 and 2,500 2-inch by 6-inch rack posts in year 2013 and 380 to 750 rack posts in 2014 (DBOC 2012b[xli]). Increased shellfish production could lead to the placement of more shellfish infrastructure such as floating bags, trays, and bottom bags in 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 expected to be negligible and will not 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.

The construction of new facilities could take place in the flood zone if alternative site locations outside of the flood zone but in the SUP area were determined to be infeasible through a subsequent planning process. If located in 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 the addition of more shells to the existing piles in the flood zone, resulting in a reduction of flood storage capacity.

Based on the information above, alternative D would result in long-term minor to moderate adverse impacts on coastal flood zones in the project area for another 10 years. Alternative D impacts on the ability of the coastal flood zone to absorb and store floodwaters or storm surges would be readily apparent. The additional infrastructure proposed under this alternative at the onshore facilities could result in the increased potential for flood damage in the project area compared to other alternatives. However, this could be mitigated by following guidelines set forth in NPS Procedural Manual 77-2, complying with Marin County building codes and FEMA recommendations for structures in the flood zone, and implementing architectural design elements specific to minimizing flood damage.

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 in 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 landward of the flood zone. 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 minor to moderate adverse impacts of alternative D, would result in a long-term minor to 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 minor to moderate adverse impacts on the coastal flood zone due to continued shellfish operations. Structures would remain in the flood zone, which could result in an increased potential for flood damage to property or environmental contamination at the project site. Alternative D impacts on the ability of the coastal flood zone to absorb and store floodwaters or storm surges would be readily apparent. The additional infrastructure proposed under this alternative at the onshore facilities could result in the increased potential for flood damage in the project area compared to other alternatives. However, this could be mitigated by following guidelines set forth in NPS Procedural Manual 77-2, complying with Marin County building codes and FEMA recommendations for structures in the flood zone, and implementing architectural design elements specific to minimizing flood damage. Compared to alternatives B and C, alternative D would result in a slight increase of 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 in the flood zone if alternative site locations outside the flood zone but in the SUP area were determined to be infeasible through a subsequent planning process. If located in 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 in the flood zone, resulting in a reduction of flood storage capacity. The cumulative impact would be long term minor to moderate, and adverse, and alternative D would contribute an appreciable adverse increment to the cumulative impact.

Alternative D would include new onshore development, which is a Class I Action as specified in the NPS *Procedural Manual 77-2: Floodplain Management*. As such, the new structure would require a SOF if alternative site locations outside the coastal flood zone, but in the SUP area, were determined to be infeasible. The SOF process would ensure that the structure is properly designed and constructed in a way that minimizes impacts to the flood zone. However, any remaining structures are grandfathered, and do not have to comply with these guidelines.

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 (NPS 2006d).

- Work with appropriate governmental bodies to obtain the highest possible standards available under the CWA for the protection of park waters;

- Take all necessary actions to maintain or restore the quality of surface waters and groundwaters in the parks consistent with the CWA 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.

The 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 (Anima 1990[xlii], Press 2005), and is characterized as a shallow, open embayment, with an average subtidal depth of around 6.5 feet at high tide (Anima 1990[xliii], Wechsler 2004[xliv]). 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. Salinities in Drakes Estero approach coastal Pacific salinities (around 34 parts per thousand) (NOAA 2010). With an average depth of 6.5 feet (CCC 2007a) and a tidal range of approximately 6 feet, Drakes Estero exchanges a substantial portion of its high-tide volume each tidal cycle with Drakes Bay. Overall, 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.

Nutrient levels in Drakes Estero are greatly influenced by upwelling conditions derived from oceanic water that enters the Estero each tidal cycle (NAS 2009). Likewise, harmful algae blooms such as red tide and algae causing PSP can occur anywhere along the California coastline on a regional scale. On occasion, such blooms can also be imported into Drakes Estero by tidal action, affecting the shellfish cultured by DBOC. DBOC currently participates in a state-wide monitoring plan to detect harmful algae consumed by commercial shellfish.

Other than the chemical and biological conditions from oceanic waters, there are three direct sources that affect water quality in Drakes Estero: runoff from cattle operations in the watershed, the biological effects of the oysters, and the actions of the shellfish operations. The analysis assumes cattle operations will remain constant throughout the next 10 years. With regard to biological effects of the oysters, Newell (2004) and Dumbauld, Ruesink, and Rumrill (2009) provide excellent summaries of the ecological effects of bivalves, one of which is the improved water quality from oysters filtering sediments, nutrients, and phytoplankton from the water column. However, it should be noted that most of the studies showing measurable beneficial effects of bivalve filtering were conducted in estuaries with relatively turbid waters full of particulates, with low to moderate tidal flushing. By contrast, Drakes Estero has a high flushing rate and is not a highly turbid coastal embayment (Wechsler 2004[xlv], NAS 2009).

The only data measuring the filtering effects DBOC oysters may have on water quality in Drakes Estero is from Wechsler (2004[xlvi]), which indicates that no appreciable difference exists between water quality samples taken in Schooner Bay immediately adjacent to racks compared to Estero de Limantour where no mariculture occurs. Several reasons may explain this outcome. Many of the oysters grown by DBOC are

placed in the main body of Drakes Estero on racks or in bags on the sandbars and mudflats up to 9 months (DBOC 2012b[xlvii]). At these locations, residence times are rather short, and oysters are often not in contact with the water during low tide particularly when oysters are hardened, thus reducing the time and the amount of water filtered during a typical tidal cycle. Another factor affecting the filtering capacity is individual oyster size NAS (2012). The number of adult oysters in Drakes Estero on any one day is but a fraction of the annual production rate, and much of the cultured oysters capable of filtering the water comprise small juvenile size classes that provide lower daily filtration rates compared to adults (Powell et al. 1992). Given these conditions, bivalve contributions to water quality at Drakes Estero are likely to be relatively minor.

The evaluation of impacts related to shellfish operation activities and the role of shellfish in marine biology and water chemistry processes could be unnecessarily duplicated between impact topics in this EIS. This section evaluates impacts on water quality in the broad context of shellfish operation 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 other sections of this chapter (i.e., "Impacts Wildlife and Wildlife Habitat: Benthic Fauna," "Impacts on Wildlife and Wildlife Habitat: Fish," and "Impacts on Eelgrass"). ,

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 shellfish operations such as onshore stormwater runoff, boat operation, intermittent disturbances to Drakes 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, use of treated lumber for racks, and cattle waste from nearby pastures. Although Zubkousky (2011) describes pollution sources as "solely non-point," the discharge (recycling) of pumped water drawn from Drakes Estero used to fill the setting tanks and to wash harvested shellfish could be considered a point source. However, 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.

Studies on water quality related to commercial shellfish operations have been performed worldwide in a vast array of aquatic regimes. The assessment in this EIS relies on data specific to the immediate project area, and inferences based on offsite studies in similar environments were used as supporting information. Onsite studies include the work over decades by the CDPH regarding harmful bacteria and toxic algae, water quality reporting by Anima from the early 1990s, and Wechsler's work measuring nutrients and turbidity levels from 2003. Because shellfish are filter feeders, it was important as part of this assessment to look at the onsite studies to evaluate the influences, if any, DBOC shellfish may have on water quality. In this regard, the only data at Drakes Estero that compares water quality parameters in Schooner Bay (commercial shellfish operations) and in Estero de Limantour (no commercial shellfish operations) was collected by Wechsler. This data was used in the analysis. Offsite studies were utilized where onsite data gaps existed.

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

Negligible: The impact is not detectable or measurable.
Minor: Impacts on water quality would be slightly detectable and localized (affecting areas adjacent to culture beds) and would not alter natural water quality conditions in the project area.
Moderate: Impacts on water quality would be readily apparent and would alter natural water quality conditions in the project area.
Major: Impacts on water quality would be readily apparent and widespread and would severely alter the natural water quality conditions in the project area.

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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

Bivalves can play an important role in water quality as suspension feeders (Dame 1996; Mazouni et al. 1996; Gilbert et al. 1997; Newell 2004; Dumbauld, Ruesink, and Rumrill 2009). Shellfish are capable of capturing and processing suspended inorganic silt, organic particulates, and phytoplankton from the water column, thus reducing water turbidity and allowing more sunlight to reach the bottom substrate. Bivalves, through ingestion and processing of suspended particles, also remove nitrogen and phosphorus from the water column, and either sequester these nutrients as tissue and shell or transfer these materials as feces and pseudofeces deposited to the sediment surface. Some of the nitrogen absorbed by bivalves is excreted as urine back into the water column elevating the level of dissolved nitrogen as ammonia for use by new phytoplankton and microbenthic organisms (Newell 2004).

In the context of Drakes Estero, nutrient inputs are primarily a function of Drakes Estero's physiographic structure (i.e., shallow lagoon with a high tidal prism) (Wechsler 2004[xlviii]) allowing tidal flushing from upwelling (Kozloff 1983; Morgan 2001) with short residence periods (NAS 2009; Dumbauld, Ruesink, and Rumrill 2009). The pollutants entering Drakes Estero from the watershed are diluted by the large volume of water entering the lagoon each high tide and transported out to Drakes Bay during each low tide. Wechsler (2004) found that the water quality parameters measured adjacent to oyster racks were virtually the same as those collected from waters far removed from oysters (Estero de Limantour). These measurements support a conclusion that water quality in Drakes Estero is influenced by oceanic sources (Kozloff 1983; Morgan 2001) derived from large input volumes each tidal cycle much more so than the presence of filter feeding bivalves. The physiographic characteristic, coupled with few human-caused

disturbances in a relatively small watershed (Zubkousky 2010), are the overriding properties of Drakes Estero affecting water quality. Again, bivalves do capture pollutants as their food source, and can influence water quality in some estuaries (Mazouni et al. 1996; Newell 2004). Site specific water quality data measured by Wechsler (2004[xlix]) suggest the water quality conditions in Schooner Bay with shellfish are very similar to Estero de Limantour where no commercial shellfish operation is present.

NAS (2012) estimated the time required for DBOC oysters to filter all of the water in Drakes Estero to be 34 days. There are a number of assumptions that are inherent in this calculation that raise the level of uncertainty for the basis the NAS conclusion. The NAS assumes that residence time in Schooner Bay is 1-2 weeks, and acknowledges that residence time in the main body of Drakes Estero is less than 1 day. The calculations and assumptions made by the NAS (2012) report appear to assume that all oysters are being grown in areas where water residence times are on the order of 1-2 weeks. In fact, many of the oyster racks and nearly all of the bottom bag and shell hardening areas are located on sand bars in the main body of Drakes Estero where the water residence time is less than one day. DBOC has indicated that most of the strings from the racks are placed on sand bars for shell hardening for a period of 2 to 9 months (DBOC 2012b[l]). Most of the oysters on racks are exposed to the air twice daily during the low tide cycle, and all of the bags and strings for shell hardening on sand bars are exposed twice daily. The NAS assumption is that the oysters are filtering 24 hours per day. NAS (2012) cited filter rates per oyster ranging between 20 to 50 gallons per day (0.075 to 0.19 m^3/day). The NAS (2012) uses the lower range of 20 gallons based on a study by Powell et al. (1992) for their assumption. However, the model that most accurately estimates oyster filter rates, according to the Powell et al. study, requires that an oyster must be over 4 inches long to filter 20 gallons of water per day. Oyster sizes on any given day range in size from seeds less than 0.5 inches long to harvest-size adults. Recognizing that market size for Pacific oyster is generally 3-4 inches, it can be assumed that many of the DBOC oysters in Drakes Estero are less than 4 inches long. Therefore the reported filtration rate for most cultured oysters present in Drakes Estero would be expected to have filtration rates lower than 20 gallons per day.

Assuming 2 inches as a reasonable average oyster length for all oysters in the Estero (juveniles and adults), the filter rate for a 2-inch oyster is 6.3 gallons per day (0.024 m^3/day) according to Powell et al. (1992). Even if using the annual production rate of 5,340,000 oysters (an overestimate compared to the actual number of oysters in the Estero on any given day), DBOC oysters would only filter less than 1 percent (0.94 %) of the water in Drakes Estero each tidal cycle based on the volume of water in Drakes Estero of 13,629,974 m^3 as calculated by NAS (2012). This equates to an estimated time required for DBOC oysters to filter all of the water in Drakes Estero to be just over 106 days assuming a closed system. With less than 1 percent of Drakes Estero being filtered by DBOC oysters each tidal cycle and the findings by Wechsler (2004[li]), these data suggest that ceasing shellfish operations and removing the functional ability of the oysters to filter water within Drakes Estero is not likely to result in any appreciable differences in water quality.

Pathogenic water quality monitoring conducted by the CDPH indicates that the inputs from upstream sources originating from the cattle ranches intermittently affect the pathogen levels in the upper bays of Drakes Estero. The upper reaches of the bays are included in the current permit area. Yet because of CDPH's mandate to protect the health and welfare of the public consuming DBOC oysters, DBOC is prohibited from having culture beds in those areas where filter feeding benefits to water quality could otherwise be most beneficial. Nonetheless, fecal coliform levels measured from water samples collected by DBOC were found to be far below the level required for shellfish growing waters. In addition, water

quality monitoring data collected from Drakes Estero reveal that the water quality standards for pathogens are far below the thresholds required for contact recreational use (including swimming and boating). The removal of the commercial shellfish operations, including the existing facilities, would not be expected to modify the pathogen levels appreciably, or result in a pollutant level that would prohibit the continued use of Drakes Estero for recreation.

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 would benefit water quality in the project area.

In general, the effects of pressure treated wood on water quality in an estuary are strongly dependent upon the amount of wood, the age of the wood, and the dilution caused by water movement (Weis and Weis 1996, NOAA 2009). Two common preservatives used in the region include ammoniacal copper zinc arsenate (ACZA) and chromate copper arsenate (CCA), both of which have the ability to release copper into the aquatic environment.

The majority of leaching from wood treated with ammoniacal copper zinc arsenate (ACZA) in saline waters occurs in the first 10 days (Brooks 1995, NOAA 2009). For wood treated with chromate copper arsenate (CCA), all of the leaching occurs in the first 90 days (Sanger and Holland 2002). Consequently, the wooden structures in Drakes Estero, whether treated with ACZA or CCA, 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.

Equipment from the racks and bags have 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).

Removal of the offshore infrastructure is expected to cause temporary sediment disturbances to the Drakes Estero bottom over the course of 2 to 3 months, resulting in particulate accumulation in the immediate work area as 4,700 posts are removed. Dismantled boards would be transferred by boat to the onshore facilities where the boards would be disposed at an offsite location. Standard BMP practices would be implemented during the rack removal process. This would be a one-time action, compared to intermittent disturbances from multiple visits to the offshore infrastructure related to continued oyster cultivation under the action alternatives. Sediment disturbances from boats, anchors, and walking personnel dismantling the racks and collecting bags etc. would cause a temporary increase in turbidity that could affect localized fish and shellfish populations. Removal of structures would be conducted using silt curtain and other BMPs to minimize sediment disturbance or transport to the area around the racks. 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 to satisfy CDPH, which would eliminate the need for boat traffic to the water quality stations, particularly those in the upper reaches of the bays where boat traffic is solely for collecting water samples.
Onshore operations would cease under alternative A, and DBOC equipment and personal property would be removed. In addition, the dock, work platform, and stringing shed damaged during the March 2011 storm would be removed for health and safety purposes. Several additional temporary structures would be removed from the onshore area. During removal of these features, standard BMP practices will be

employed to reduce sediment erosion into the neighboring wetlands or other waters. Collectively, the removal of these structures could cause onshore soil disturbances, resulting in a temporary increase in non-point-source runoff pollution until the soil is stabilized. Sediment erosion into neighboring wetlands or other waters could cause local turbidity levels to temporarily rise, impacting wildlife and fish habitats in wetlands and other waters. Tidal flushing would dissipate any turbid waters, resulting in these impacts being short-term.

Removal of onshore facilities could 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 tanks would be pumped, and its operation would be discontinued with closure of the remaining structures. Therefore, 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 washing station 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.

Although DBOC facilities would be removed, 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. 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 some 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 discussed as a cumulative action below.

As described 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 in the project area. These actions include restoration of the developed onshore area following SUP expiration,

the existing fire management plan, coastal watershed restoration projects in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), existing ranching operations, and moving the vault toilet out of the flood hazard area.

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 in 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 in the project area. Additionally, recent coastal watershed restoration projects in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project) included removal of existing structures with the potential to fail. As such, recent watershed restoration efforts have resulted in beneficial impacts on water quality in Drakes Estero. Ranching activities, such as those performed in the Seashore, have the potential to introduce animal waste (fecal coliform) into the watershed via runoff. NPS will continue to work with ranchers to identify and implement BMPs to reduce potential pollutant loading to waterbodies throughout the Seashore. Continued ranching in 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 in 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 in Drakes Estero. Alternative A would contribute a noticeable beneficial increment to the cumulative impact.

Conclusion

Drakes Estero is not a highly turbid coastal embayment (NAS 2009), and based on west coast research (Dumbauld, Ruesink, and Rumrill 2009), the beneficial biochemical effects typically attributed to bivalves, such as nutrient cycling and water clarity, are expected to be highly localized in Drakes Estero. This is because the nutrient dynamics in these systems are driven by coastal upwelling and a strong tidal cycle rather than by bioprocesses from shellfish. However, bivalves remove particulates in the water column that may influence eelgrass productivity near beds and racks (see discussion under alternative B).

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. No releases of toxic levels of copper from wood preservatives would be expected under this alternative. The 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 and beneficial, and alternative A would contribute a noticeable beneficial increment to the cumulative impact.

With regard 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 in 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 motorized boat traffic
- Installation of sediment filter at the onshore facility

As filter feeders, shellfish provide beneficial water quality functions with their ability to remove suspended solids, nutrients, and phytoplankton from the water column. Nutrients entering Drakes Estero are primarily derived from oceanic sources. Pollutant runoff from cattle operations and other non-point sources from the relatively small watershed enter Drakes Estero. Because these pollutants have the potential to be captured and processed by the cultivated shellfish, harvesting restrictions are in place to protect public health. Under this alternative, cultivated shellfish would remain in Drakes Estero providing localized benefits to water quality by filtering and processing a portion of those pollutants entering the water from the watershed. As discussed in alternative A, however, the overriding influence affecting water quality is the ability of Drakes Estero to drain most of its water at low tide and replace that water during the next high tide cycle with upwelled oceanic water transporting a renewed supply of nutrients (Kozloff 1983; Morgan 2001).

Wechsler's study (2004[lii]) compared water quality parameters adjacent to oyster racks in lower Schooner Bay with samples taken in the Estero de Limantour where no oysters are cultured. The study found no appreciable difference in water quality. This can be explained by the fact that DBOC oysters are cultured primarily in the main body of Drakes Estero where the residence time is short compared to the upper fingers of the bays. Additionally, the volume of water filtered by a single oyster is directly related to the size of the oyster (Powell et al. 1992), and many of the oysters cultured in Drakes Estero on any given day are juveniles with low filter rates compared to adults. Furthermore, the majority of oysters are located on racks, sandbars, and mudflats that are not in contact with water during low tide, particularly those oysters set aside during the shell hardening process. An analysis of the daily filter rate resulted in less than one percent of the water in Drakes Estero is filtered by DBOC oysters (see alternative A discussion). Based on these conclusions, DBOC oysters have limited ability to measurably alter water quality in Drakes Estero.

Impacts on water quality from managing the offshore facilities would be expected to be intermittent, occurring when employees visit racks and bags. DBOC's permitted growing area would include up to 138 acres of culture beds, including 84 acres for bottom bag culture. DBOC operations have the potential to cause impacts such as temporary intermittent sediment disturbances to the Drakes Estero bottom, resulting in higher than normal particulate concentrations in 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 intermittent disturbances include workers walking across mudflats, boat hulls running aground on the mudflats, and bag maintenance/harvesting actions. These activities occur approximately eight hours a day six days each week, 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. Continued 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. Also, as indicated by DBOC (DBOC 2012b[liii]) floating culture is currently anchored on existing dilapidated racks and in areas immediately adjacent to existing rack culture. Under alternative B, all racks (once repaired) would likely be fully utilized for wire culture (DBOC 2012b[liv]), and floating culture comprised of concrete anchors and attached lines may be relocated to areas adjacent to racks using concrete anchors, etc. Water quality from such actions 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.

Between 2005 and 2007, DBOC conducted repair of racks using AZCA treated wood as authorized by the NPS. Repair to the racks was discontinued in 2007 as a result of a CCC Cease and Desist Order issued to DBOC for unpermitted activities, and to-date, repair of racks have not resumed. Replacement of offshore wooden structures would occur under this alternative. Alternative B is expected to maintain the same number of oyster racks currently in use, which amounts to 95 racks spaced across the larger 1,083-acre, open water leased area. Of these 95 racks, 50 racks would be replaced in year 2013 and 25 racks replaced in year 2014. Wooden racks and a new dock constructed from pressure-treated lumber would remain until year 2022.

The most commonly used chemical treatments for lumber in marine environments are either ACZA or CCA. Most of the preservatives remain affixed to the wood fibers; however, some may leach into the aquatic environment to remain in solution, become absorbed by aquatic plant life (Lyngby and Brix 1984) or become attached to sediment once submersed in water (Brooks 1996; Weis and Weis 1996). Scientists have discovered that most of the leaching of ACZA occurs in the first 10 days of exposure to salt water (NOAA 2009), whereas Sanger and Holland (2002) describe the amount of CCA leaching in water decreases by approximately 50 percent each day, and 99 percent of the leaching is completed in the first 90 days after installation. The Western Wood Preservers Institute (2011) developed a model used to estimate dissolved copper concentrations in aquatic environments resulting from treated wood leachates. This model, known as the box model, estimates copper leachate concentrations from a single project based on a construction timeline of 0.5 days, which is not applicable to since it will take months to repair racks. Furthermore, the model does not take into consideration other factors such as plant absorption of soluble copper, which can be significant (Lyngby and Brix 1984), or the use of sealants. Thus, the model is not a useful tool in accurately predicting copper leachate concentrations in this analysis.

Because of the large quantity of treated lumber necessary to replace racks by year 2014, regulatory approvals would be necessary under this alternative. DBOC would be required to submit a site-specific plan and repair schedule for agency review. In 2011, the USACE issued an emergency permit for the dock damaged by the March 20, 2011 storm, and as a condition to that permit, they required "any chemically treated wood material must be coated with an impact-resistant biologically inert substance" (USACE 2011b). Regulatory approvals for rack replacement will likely include such a mitigating step as using a wood sealant to reduce copper leachates, as well as conducting repairs during the summer months when coho salmon and steelhead are less likely to occupy Drakes Estero for spawning (Busby et al. 1996, Good et al. 2005, NMFS 2010).

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 includes the one-time 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[lv]) 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[lvi]) 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.

The offshore shellfish operation has historically caused debris from shellfish operations such as floats, spacers, and tubes to unintentionally become dislodged and deposited in the aquatic environment of Drakes Estero. While realizing this as an ongoing possibility, the degree and intensity to which materials could become dislodged in the future is unknown. The various forms of debris are accepted materials for use in culturing shellfish. However, once dislodged, the materials become a pollutant. The conditions of the SUP and the CCC CDO would require that DBOC continue to remove marine debris from shellfish operation equipment. It is assumed that under alternative B, limited incidental debris related to commercial shellfish operations would continue to be present in the aquatic environment. DBOC cleanup procedures also would disrupt water quality should workers disturb the soft bottom of Drakes Estero when retrieving loose debris from intertidal mudflats.

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 offshore shellfish 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 in 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 currently 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 microalgae as a food source for the 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 amount of microalgae).

Alternative B would include removal of the existing conveyor washing station and replace this facility with a new conveyor system and work platform that would include a sediment trap to filter water from the washing station before the water is allowed to reenter the Drakes Estero. Treatment of spray wash would be a beneficial effect on water quality discharge back to Drakes Estero. Sediments and fouling organisms would be allowed to settle at the bottom of the wastewater vault for periodic removal, and thus decrease the sediment loads entering Drakes Estero and local turbidity compared to the existing spraying system. This point-source discharge is not expected to 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.

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 short-term minor adverse and long-term minor adverse impacts on water quality for another 10 years because this alternative would include temporary, localized impacts (affecting areas adjacent to culture beds) that would not have long-lasting effects on water quality (but would occur regularly) and would not alter natural water quality conditions. These temporary, localized impacts to water quality would be slightly detectable (affecting areas adjacent to culture beds) and would not alter natural water quality conditions in the project area.

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 in 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 in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossing Improvement Project), existing ranching operations, and moving the vault toilet out of the flood hazard area.

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 in 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 short-term minor adverse as well as long-term minor adverse impacts on water quality for another 10 years. Alternative B would include activities causing intermittent disturbances to water quality that would result in recurring but not long-lasting effects on water quality. These temporary, localized impacts on water quality would be slightly detectable (affecting areas adjacent to culture beds) and would not alter natural water quality conditions in the project area. Cultivated shellfish as filter feeders would remain in Drakes Estero under this alternative, offering localized long-term beneficial impacts on water quality by removing suspended solids, nutrients, and phytoplankton from the water column. Sediment disturbances from offshore shellfish operations (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 that would be mitigated by a floating silt screen. This alternative would include the replacement of between

1,700 and 2,500 posts in 2013 and between 380 and 750 posts in 2014 which also result in short-term adverse impacts on water quality as the sediment is disturbed. The use of pressure treated lumber to repair existing offshore racks and to construct a new dock is not expected to introduce wood preservatives containing copper into the water because it is assumed that mitigating conditions such as the use of sealants would be employed as part of regulatory permit conditions. 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 water from the washing station after sediments and fouling organisms are filtered from the sediment basin resulting in beneficial impacts; no chemical contaminants would be discharged into Drakes Estero under this alternative. The amount of non-point-source pollution from runoff associated with the onshore facilities is currently very small (less than 3 acres of impervious surface in a watershed of several square miles). The cumulative impact would be long term, minor, and adverse, and alternative B would contribute a noticeable adverse increment to the cumulative impact.

With regard 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 in 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 reduced by 186 acres; however, DBOC's racks and bags would occupy generally the same area as under alternative B. Impacts due to the production limit of 500,000 pounds per year under alternative C would be similar as those described for the 600,000 pounds production limit under alternative B.

Under this alternative, cultivated shellfish would remain in Drakes Estero providing localized benefits to water quality by filtering and processing a portion of those pollutants entering the water from the watershed. As discussed in alternative A, however, the overriding influence affecting water quality is the ability of Drakes Estero to drain most of its water at low tide and replace that water during the next high tide cycle with upwelled oceanic water transporting a renewed supply of nutrients (Kozloff 1983; Morgan 2001). Many of the oysters are not full-sized adults with high filter rates, and most oysters are not in contact with the water column during low tide. Considering these factors, an analysis of the filtering capacity of DBOC oysters, similar to alternative B, determined that less than one percent of Drakes Estero would be filtered by oysters each tidal cycle under this alternative.

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 short-term minor adverse and 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 in historical water quality conditions. These temporary, localized impacts to water quality would be slightly detectable (affecting areas adjacent to culture beds) but would not alter natural water quality conditions in the project area.

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 in 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 in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossings Improvement Project), existing ranching operations, and moving the vault toilet out of the flood hazard area.

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 in 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 short-term minor adverse as well as long-term minor adverse impacts on water quality for another 10 years. Alternative C would include activities causing intermittent disturbances to water quality that would result in recurring but not long-lasting effects on water quality. These temporary, localized impacts on water quality would be slightly detectable (affecting areas adjacent to culture beds) but would not alter natural water quality conditions in the project area. Alternative C would have recurring but not long-lasting effects on water quality. 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 on water quality would include those described under alternative B. In particular, sediment

disturbances from offshore shellfish operations (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. This alternative would include the replacement of between 1,700 and 2,500 posts in year 2013 and between 380 and 750 posts in 2014, which would also result in short-term adverse impacts on water quality due to sediment disturbance. The use of pressure-treated lumber to repair existing offshore racks and to construct a new dock is not expected to introduce wood preservatives containing copper into the water because it is assumed that mitigating conditions such as the use of sealants would be employed as part of regulatory permit conditions. Dredging around the floating dock would be expected to create temporary disturbances to the water column from increased turbidity, resulting in short-term adverse impacts on water quality. Standard BMPs would be employed during dredging such as the use of a floating silt screen. Point-source discharges would include discharging water from the washing station after marine sediments and fouling organisms are filtered and removed from the new sediment basin; no chemical contaminants would be discharged into Drakes Estero under this alternative. The amount of non-point source pollution from runoff at the onshore facility is currently very small (less than 3 acres of impervious surface in a watershed of several square miles). The cumulative impact would be long term, minor, and adverse, and alternative C would contribute a noticeable adverse increment to the overall cumulative impacts.

With regard 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 in 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 approximately 40 percent compared to alternative B (600,000 pounds per year) and a 70 percent increase compared to alternative C (500,000 pounds per year). Alternative D is not expected to increase the size or extent of the offshore racks. On the other hand, if more cultivated shellfish are placed in Drakes Estero, this alternative would provide a higher level of localized water quality benefits as the higher quantity of shellfish would be available to filter and process more pollutants from the water column compared to the other alternatives. The higher production rate may require more frequent boating trips to the offshore facilities for shellfish cultivation. This work would be in combination with boat trips to repair racks as discussed under alternative B, causing additional short-term 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. Also, as indicated by DBOC (DBOC 2012b[lvii]) floating culture is currently anchored on existing dilapidated racks and in areas immediately adjacent to existing rack culture. Under alternative D, all racks (once repaired) would likely be fully utilized for wire culture (DBOC 2012b[lviii]), and floating culture comprised of concrete anchors and attached lines may be relocated to areas adjacent to racks using concrete anchors, etc. The continued risk of mariculture-related structures contributing to plastic debris in Drakes Estero would continue and would be similar to the impacts described in alternative B. Thus, impacts on water quality collectively from sediment disturbances caused by these offshore activities are expected to be slightly higher than those described for alternatives B and C.

Just as with alternatives A, B and C, the overriding influence affecting water quality is the ability of Drakes Estero to drain most of its water at low tide and replace that water during the next high tide cycle with upwelled oceanic water transporting a renewed supply of nutrients (Kozloff 1983; Morgan 2001). Cultivated shellfish would remain in Drakes Estero under alternative D providing localized benefits to water quality by filtering and processing a portion of those pollutants and nutrients entering Drakes Estero from oceanic inputs and runoff from the watershed. The amount of water filtered by DBOC oysters under alternative D would be slightly higher compared to alternatives B and C due to the higher production rate.

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. Construction of the new building would be conducted using appropriate BMPs to reduce sedimentation. A site specific construction plan and BMPs would be required to reduce sediment loading from the construction site to Drakes Estero. Short-term minor adverse impacts on water quality may occur 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 short-term minor adverse and 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 be occur regularly) and would be in historical water quality conditions. These temporary, localized impacts to water quality would be slightly detectable (affecting areas adjacent to culture beds) but would not alter natural water quality conditions in the project area. However, this alternative could cause slightly higher rates of sediment disturbance in Drakes Estero, compared to alternatives B and C, due to more 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 in 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 in the Seashore (Geomorphic Restoration Project and Drakes Estero Road Crossings Improvement Project), existing ranching operations, and moving the vault toilet out of the flood hazard area.

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 in 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 as well long-term minor adverse impacts on water quality for 10 more years due to offshore and onshore activities associated with commercial shellfish operations in 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. These temporary, localized impacts on water quality would be slightly detectable (affecting areas adjacent to culture beds) and would not alter natural water quality conditions in the project area. Alternative D would have the highest population of cultivated shellfish occupying Drakes Estero. As a result, the localized water quality benefits from filter feeding bivalves would be greater 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. The use of pressure-treated lumber to repair existing offshore racks and to construct a new dock is not expected to introduce wood preservatives containing copper into the water because it is assumed that mitigating conditions such as the use of sealants would be employed as part of regulatory permit conditions. 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. Standard BMPs, such as the use of a floating silt screen, would be employed during dredging. Onshore discharge into Drakes Estero of pumped water serving the washing station and setting tanks would be filtered using the new sediment basin, resulting in beneficial impacts on water quality. In addition, onshore sediment may enter waters due to the construction of new facilities, although this action could be mitigated through a site-specific construction plan and the use of standard BMPs. Alternative D also would result in short-term minor adverse impacts on water quality during the 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, and adverse, and alternative D would contribute a noticeable adverse increment to the cumulative impact.

With regard 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 in 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 dBA 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. A-weighting is based on human hearing capabilities. Comparative studies of vertebrate hearing suggest that dBA values are likely to overstate the perceived loudness of noise for all terrestrial vertebrates at Point Reyes. Dooling and Popper (2007) note that humans have better auditory sensitivity than most birds. Humans have better low frequency hearing than most terrestrial mammals that have been studied (Fay 1988). Mammals that are known to have better low frequency hearing than humans are baleen whales (Ketten 1994), elephants (Heffner and Heffner 1982; Poole et al. 1988), and kangaroo rats (Heffner and Masterton 1980); however, none of these mammals are found in the project area.

The impact analysis below is base on available measurements from in or adjacent to the project area as well as a review of reference sound levels available for similar pieces of equipment. As described in chapter 3, estimates of ambient and background noise are estimated using data collected at the PORE004 station during the Volpe (2011) study. The PORE004 station was located approximately 60 yards from the shore of Drakes Estero and 2 miles from the DBOC buildings. It is just outside but immediately adjacent to the general project area established for this EIS. High bluffs block the direct line from PORE004 to the DBOC processing facilities; the buildings are not in view, and the direct path for noise is blocked by terrain. Although some boat noise is audible at this site, the PORE004 site was not in an ideal location for measuring DBOC boat noise.

The DBOC equipment descriptions and frequencies of use are based on information provided by DBOC (DBOC [Lunny], pers. comm., 2011h). NPS did not obtain noise measurements of operational DBOC equipment in Drakes Estero. Data were provided by Environ International during the public comment period for the Draft EIS (Environ 2011), but these measurements are problematic to interpret and use. Environ did not follow pertinent standards and the measurement processes and the operating conditions of the equipment were not adequately described.[2] To address these concerns, the Environ measurements were compared with reports that document noise levels measured under specified conditions from comparable equipment.

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 reference ambient sound level is assumed to be 34 dBA, the median (L_{50}) summer daytime measurement at the PORE004 station (Volpe 2011). This level incorporates human-caused noise

[2] NPS requested clarifying information regarding the Environ measurements from DBOC in a letter dated April 6, 2012. Clarifying information was provided to NPS in DBOC's June 5, 2012 letter. This information was reviewed; however, it did not resolve concerns regarding measurement processes and description of operating conditions.

and overstates natural background conditions. However, it relates most directly to everyday experience and serves as a reasonable upper bound for the natural ambient sound level at most locations in Drakes Estero. Higher sound levels could be found at atypical locations close to noise sources, surf, or rapidly flowing water.

- The sound level exceeded 90 percent of time – the L_{90} – is used to approximate the background or residual sound level against which all identifiable sounds are heard (ANSI S12.9-1). On the eastern shore of Drakes Estero at the PORE044 station, the daytime L_{90} was 26 dBA in summer and winter, and this may be interpreted as a lower bound for natural ambient sound level.
- Variation of sound levels in time is greater than spatial variation. Volpe data from three undeveloped sites in Point Reyes National Seashore – in very different ecological settings – show that summer daytime L_{50} values range from 32 to 35 dBA, and summer daytime L_{90} values for the undeveloped sites range from 26 to 29 dBA.
- The noise energy produced by DBOC equipment is presented as a range, based on available reference levels and on data provided by Environ during the public comment period for the Draft EIS, and a survey of reports documenting noise levels from similar equipment. This information is discussed in chapter 3 and summarized in table 3-3.
- The duration of human-caused noise as a result of DBOC activities was estimated using information provided by DBOC as presented in table 3-3. At the onshore facilities, this includes a front end loader operating two to four hours a day and an oyster tumbler operating approximately two hours per day (DBOC [Lunny], pers. comm., 2011h). Small pneumatic drills are also used approximately two hours per day (DBOC [Lunny], pers. comm., 2011h). In the estero, boats operate approximately 8 hours per day, 6 days per week, making a total of 12 round trips per day (DBOC [Lunny], pers. comm., 2011h). 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), resulting in approximately 2 hours of boat noise per day. In terms of the total duration of noise exposure, an unknown factor is the extent to which the noise sources (both onshore and offshore) are operated simultaneously. This analysis assumes that four to eight hours of noise generation occurs each day, six days per week, resulting in 24 to 48 hours of DBOC noise generation each week. As described in Appendix I, an intensive review of 52 days of Volpe recordings taken at the PORE004 station revealed that the duration of unambiguous boat noise exceeded 2.5 hours in the reception range of microphone PORE004 on one day and in terms of all potential DBOC noise, 11 days exceeded 10 percent of the day (2.4 hours). However, these findings underestimate noise exposure in Drakes Estero for the following reasons: The PORE004 site was on the periphery of DBOC operations, and unambiguous boat noise events reflect boats that were close enough to be heard and recognized. Furthermore, prevailing winds caused the PORE004 station to be upwind from the DBOC noise sources for more than 30 percent of the daylight hours. Noise refracts away from the ground when it travels upwind, so the PORE004 site would have been ineffective in detecting DBOC noise from Drakes Estero under these conditions. In addition, high bluffs block the direct line from PORE004 to the DBOC processing facilities; the buildings are not in view, and the direct path for noise is blocked by terrain. For these reasons, the duration of human-caused noise used for the analysis in this section is based on information provided by DBOC, as it is a more accurate representation of the duration of DBOC noise-generating activities, both onshore and offshore.

- This analysis omits other noise sources associated with DBOC operations (such as radios, compressors, and vehicles) that could not be readily quantified. These sources have the potential to cause additive contributions to the noise levels associated with DBOC operations. The level of additional noise caused by additional sources is unknown, but because of the possibility of additional noise, the analysis presented below may underestimate the impact of DBOC-related noise to the soundscape in the project area.

Noise levels decrease with increasing distance from the source. For this analysis, the effects of spreading or divergence loss and atmospheric absorption were used to predict the attenuation of noise with distance. Spherical spreading losses are anticipated to be 20 dBA for every tenfold increase in distance, and approximately 6 dBA for every doubling of distance. Atmospheric absorption was calculated from the formulae presented in ISO 9613-1, using an air temperature of 59 degrees Fahrenheit and a relative humidity of 80 percent (climatological averages for Drakes Estero). This resulted in an absorption coefficient of about 1.7 dBA per mile. These assumptions regarding sound propagation will underestimate the area affected by noise when a near surface inversion layer exists, as on a calm summer day when the water is much colder than the air above it. Inversions are less likely to form as wind speeds increase. 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. According to weather conditions recorded at the closest weather station to the project area (the Point Reyes RCA Station) over the course of the years 2010-2011, approximately 68 percent of days experienced an average wind speed of less than 10 miles per hour (Western Regional Climate Center 2012).

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 (EPA 1981). For example, the summer daytime L_{50} value was 34 dB, which translates to a quiet environment in which people could communicate at a normal voice level when separated by 37 feet. The summer and winter L_{90} was 26 dBA, which translates into opportunities to communicate at a normal voice level when separated by more than 90 feet. Intensity definitions based on functional consequences to human communication also serve as reasonable proxies 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. To simplify the analysis, nighttime hours are treated the same as daytime hours. As nocturnal sound levels are lower, noise impacts at night would be greater. However, most DBOC operations occur during the day. 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.”

Negligible:	The impact is not detectable or measurable.
Minor:	Human-caused noise would be at a level (less than 35 dBA) that enables normal voice conversation at distances exceeding 32 feet, and/or the natural soundscape is interfered with less than 5 percent of the time.
Moderate:	Human-caused noise would be at a level that enables normal voice communication at distances greater than 16 feet (less than 41 dBA) and less than 32 feet (greater than 35 dBA), and/or the natural soundscape is interfered with 5 to 10 percent of the time.
Major:	Human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972). Cessation of DBOC-related contributions of noise to the natural soundscape would remove the primary source of human-caused noise in 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 40 feet or more. 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 (such as those used for hunting, predator awareness, sexual communication, defense of territory, and habitat quality assessment by wildlife) would no longer be interfered with due to noise emanating from the commercial shellfish operations. 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 discussed under the cumulative impact section below), 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 in 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 in 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 between two to three months, assuming that work would take place for 10 weeks, five days per week, 8 hours per day. This schedule would result in approximately 400 hours of noise interfering with the soundscape. In other words, the natural soundscape would be interfered with for less than 5 percent of that year. In the vicinity of this heavy equipment, vocal communication would be difficult unless visitors were very close to each other. Site restoration efforts would cause 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 subsequent site restoration. Noise generated by human activities on the ground in and near Drakes Estero would be reduced dramatically.

For these reasons, 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 due to the elimination of human-caused noise associated with the commercial shellfish operation, which would result in the restoration of a substantially more natural soundscape. 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 adverse impacts on soundscapes.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact soundscapes in the project area. These actions include kayak use, planning and management activities, and other sources of human-caused noise.

Planning and management activities may call for actions that require motorboat use in Drakes Estero for research or administrative purposes. Motorboat use in Drakes Estero would continue to be subject to the minimum requirement because of the wilderness designation. Therefore, research activities in 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. The Volpe report estimates that the change in median sound levels due to all aircraft at the PORE004 site is small: 1.4 dBA in summer and 1.7 dBA in winter. According to recent data collection, overflights account for 13 percent (in the summer) to 17.6 percent (in the winter) of audible sounds at the PORE004 site located on the bluff of Drakes Estero (Volpe 2011). 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 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. 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 adverse impacts on soundscapes. The cumulative impact would be long-term and 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would impact soundscapes include use of noise-generating equipment at the shore facility and outboard boat traffic in Drakes Estero. At the end of the 10 year extension, the noise impacts described under Alternative A would ensue as the site is restored.

At the onshore facilities, mechanized equipment would continue to generate noise. This equipment includes a front end loader operating two to four hours a day and an oyster tumbler operating approximately two hours per day (DBOC [Lunny], pers. comm., 2011h). Small pneumatic drills are also used approximately two hours per day (DBOC [Lunny], pers. comm., 2011h).

The offshore racks and bags are accessed via motorboat. During a February 16, 2011 site visit, DBOC staff advised NPS that DBOC currently operates two motorboats in 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. Combined, these boats operate approximately 8 hours per day, 6 days per week, making a total of 12 round trips per day (DBOC [Lunny], pers. comm., 2011h). 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). In its June 5, 2012 response to NPS's request for additional

information, DBOC revised its description of boat use. The most noteworthy difference is that DBOC now uses three boats. DBOC did not provide a size or engine horsepower for the third boat. Otherwise, DBOC notes that the description above represents typical working conditions; however, DBOC also noted that, albeit unusual, all three boats may be in operation all day and that some weeks may require that boats be used all 7 days. DBOC also noted that on some days, no boats are in operation. DBOC must operate around variable demands, including tides, weather, day length, planting season, and high demand occasions (DBOC 2012b[lix]). Under alternative B, it is assumed that boat operations will continue at levels similar to these.

The range of operational noise levels from table 3-3 can be combined with noise propagation formulae to predict the spatial footprint of each noise source in the absence of any barriers created by terrain. The following table documents the predicted distance each noise source (using both upper and lower bounds for the range of operational noise levels discussed in chapter 3) would travel before its level would equal the ambient sound level (34 dBA) and the background sound level (26 dBA).

TABLE 4-2. SPATIAL FOOTPRINT OF DBOC-GENERATED NOISE

Equipment	Lower bound of operational noise level at 50 feet	Distance at which lower bound noise decreases to the L_{50} of 34 dBA	Distance at which lower bound noise decreases to the L_{90} of 26 dBA	Upper bound* of operational noise level at 50 feet	Distance at which upper bound* noise decreases to the L_{50} of 34 dBA	Distance at which upper bound* noise decreases to the L_{90} of 26 dBA
	dBA	feet	feet	dBA	feet	feet
Front End Loader	67	2,071	4,711	73	3,863	8,238
Pneumatic Drill	67	2,071	4,711	80	7,537	14,556
Oyster Tumbler	50	312	771	75	4,711	9,786
Motorboat	62	1,203	2,842	74	4,269	8,987

* These operational noises levels are the upper bound of the range used for the impact analysis; however, these noise levels do not represent the maximum possible noise levels produced by this equipment. Rather, these noise levels are intended to be realistic operational noise levels based on the literature cited.

Another way of considering how noise generated by DBOC operations would continue to impact the natural soundscape under this alternative is to select a few uniform benchmark sound levels associated with a particular functional consequence and compare the distances at which each noise-generating piece of equipment is expected to reach the associated sound level. The table below (table 4-3) summarizes at what distance each item meets the following criteria:

- Interferes with interpretive presentations or group leader communication (raised voice communication at 32 feet) (EPA 1981)
- Normal voice communication is degraded when visitors are separated by 17 feet or more (EPA 1981)
- Background sound levels equals desired levels for classrooms, bedrooms, auditoria, and other indoor spaces where quiet and good listening conditions are important (ANSI 2008)
- Noise equals the background or residual sound level (L_{90}) (Volpe 2011; ANSI 1988).

TABLE 4-3. FUNCTIONAL CONSEQUENCES IN THE SPATIAL FOOTPRINT OF DBOC-GENERATED NOISE

Functional Consequence	Interferes with interpretive presentations or group leader communication (raised voice communication at approximately 32 feet).*	Normal voice communication is degraded when visitors are separated by approximately 17 feet or more.*	Background sound levels equals desired levels for classrooms, bedrooms, auditoria, and other indoor spaces where quiet and good listening conditions are important.†	Noise equals the background or residual sound level (L_{90}).‡
Received noise level (dBA)	52	41	35	26
Front End Loader: Lower bound distance (feet)	279	964	1,860	4,711
Front End Loader: Upper bound distance (feet)	551	1,860	3,491	8,238
Oyster Tumbler: Lower bound distance (feet)	40	140	279	771
Oyster Tumbler: Upper bound distance (feet)	690	2,303	4,269	9,786
Pneumatic Drill: Lower bound distance (feet)	279	964	1,860	4,711
Pneumatic Drill: Upper bound distance (feet)	1,203	3,863	6,884	14,556
Motor boat: Lower bound distance (feet)	157	551	1,077	2,842
Motor boat: Upper bound distance (feet)	616	2,071	3,863	8,987

Sources: *EPA 1981, †ANSI 2008, ‡Volpe 2011; ANSI 1988

Several of these noise projection scenarios extend more than a mile (i.e., 5,280 feet), and a few approach or exceed two miles (e.g., 10,560 feet). The distance from the DBOC shore facilities to the potential wilderness boundary is 670 feet. The only scenario that does not project noise into wilderness is the lower bound of the oyster tumbler compared against the L_{50} of the environment.

Figures 4-1 and 4-2 maps the spread of noise from the shore station, assuming a 67 dBA noise source at the lower bound (figure 4-1) and 80 dBA at the upper bound (figure 4-2), respectively. Again, it should be noted that the terms upper bound and lower bound refer to the range of operational noise levels assumed in this analysis; the upper bound represented does not necessarily represent the maximum noise level that could be produced by each piece of equipment. These figures ignore the spread of noise on land. Two noise contour levels were selected for this map: 41 dBA and 35 dBA. The first (orange) represents the area receiving noise energy that exceeds 41 dBA, which is 15 dBA above the background sound level (L_{90}). In this contour, noise dominates the acoustical environment and reduces the effective listening area for other sounds in the same frequency band by 97 percent. The outer contour (yellow) represents the area in which the received noise level exceeds 35 dBA. In this contour, noise exceeds the background sound (L_{90}) level by 9 dBA, reducing the effective listening area for other sounds occupying the same frequency band will be reduced by 87 percent.

Figures 4-3 and 4-4 both depict four examples to show how noise would spread from a boat at different locations in Drakes Estero. As above, these figures show the point at which sound would be expected to exceed 41 dBA and 35 dBA, respectively, at a moment in time. Under the boat operating conditions described earlier, intermittent motorboat travel impacts the natural soundscape for two hours a day. Kayakers that are in 550 feet of cruising motorboat would experience degraded normal voice communication when separated by 17 feet or more due to noise levels being greater than 41 dBA using the lower bound of anticipated noise generation. Motorboat noise would be audible in large areas of Drakes Estero when a DBOC boat is underway.

The tables above document the area around each individual noise source that would experience various levels of noise exposure. When more than one noise source is operating at the same time, noise exposures would be higher. In terms of the total duration of noise exposure, an unknown factor is the extent to which the noise sources are operated simultaneously. This analysis assumes that 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 each week, which translates to approximately 14 to 29 percent of the 10 year permit.

Transiting motorboats and onshore sources of noise would project noise audible to park visitors thousands of feet under the most conducive weather conditions. For portions of Drakes Estero that have an unobstructed view of the processing facility, some noise from the shore operations may be audible at distances exceeding 2.5 miles. Although additional sounds such as radios and other vehicles are not quantified, they may contribute to the noise emanating from the DBOC onshore site as well as from boats (where radios may be taken on board).

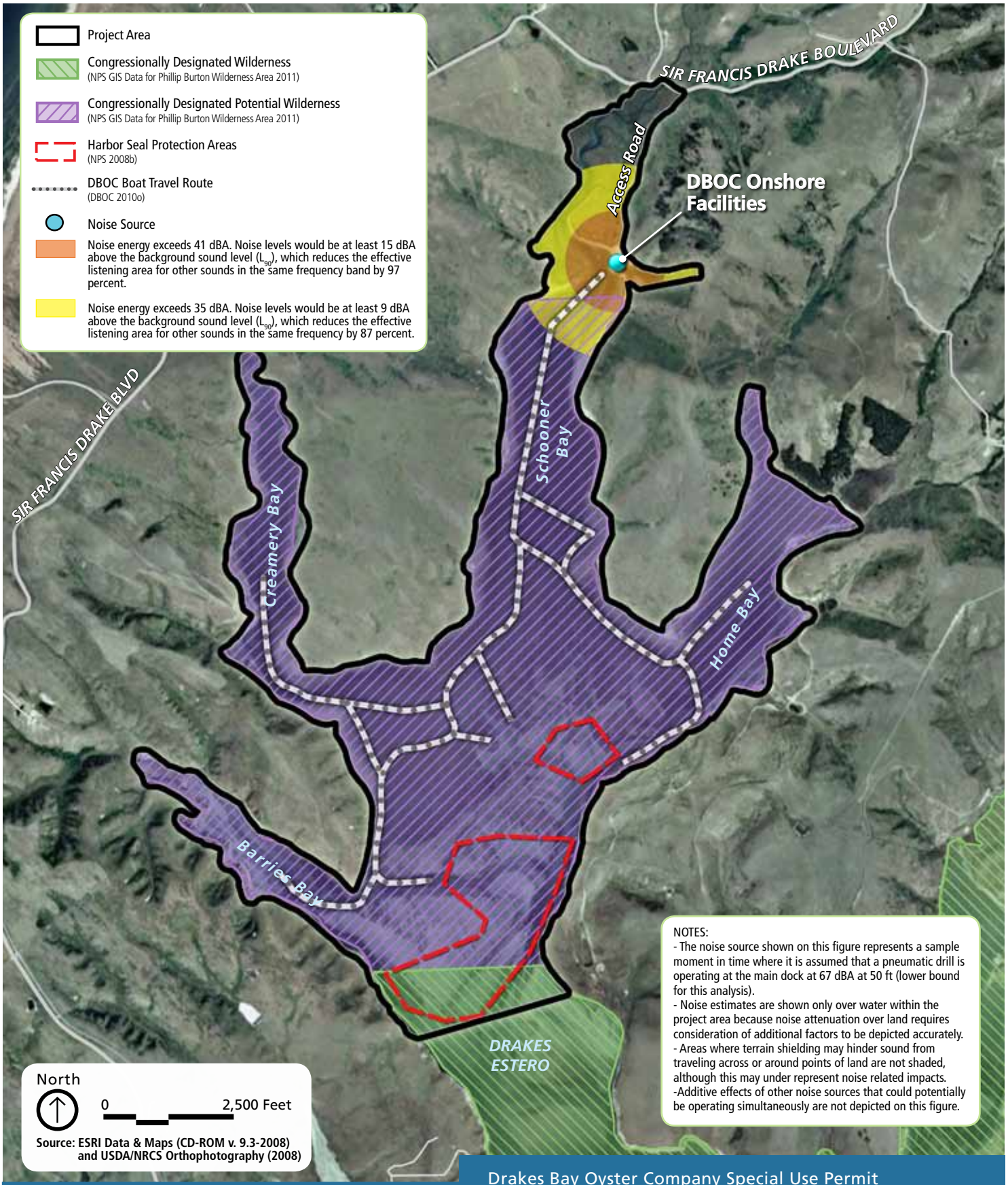

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FIGURE 4-1

DBOC Noise Generation - Onshore Facilities (Lower Bound)

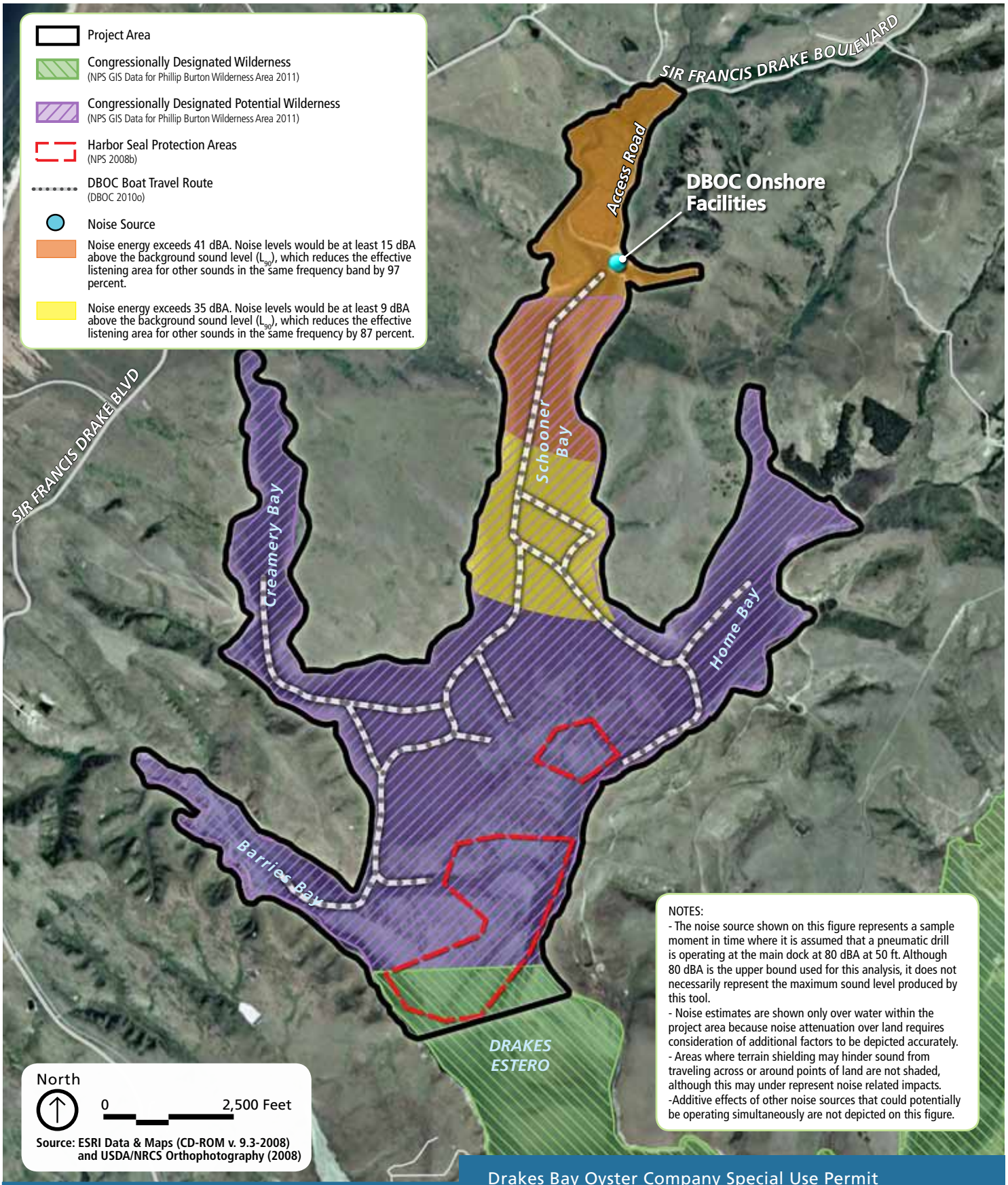

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FIGURE 4-2

DBOC Noise Generation - Onshore Facilities (Upper Bound)

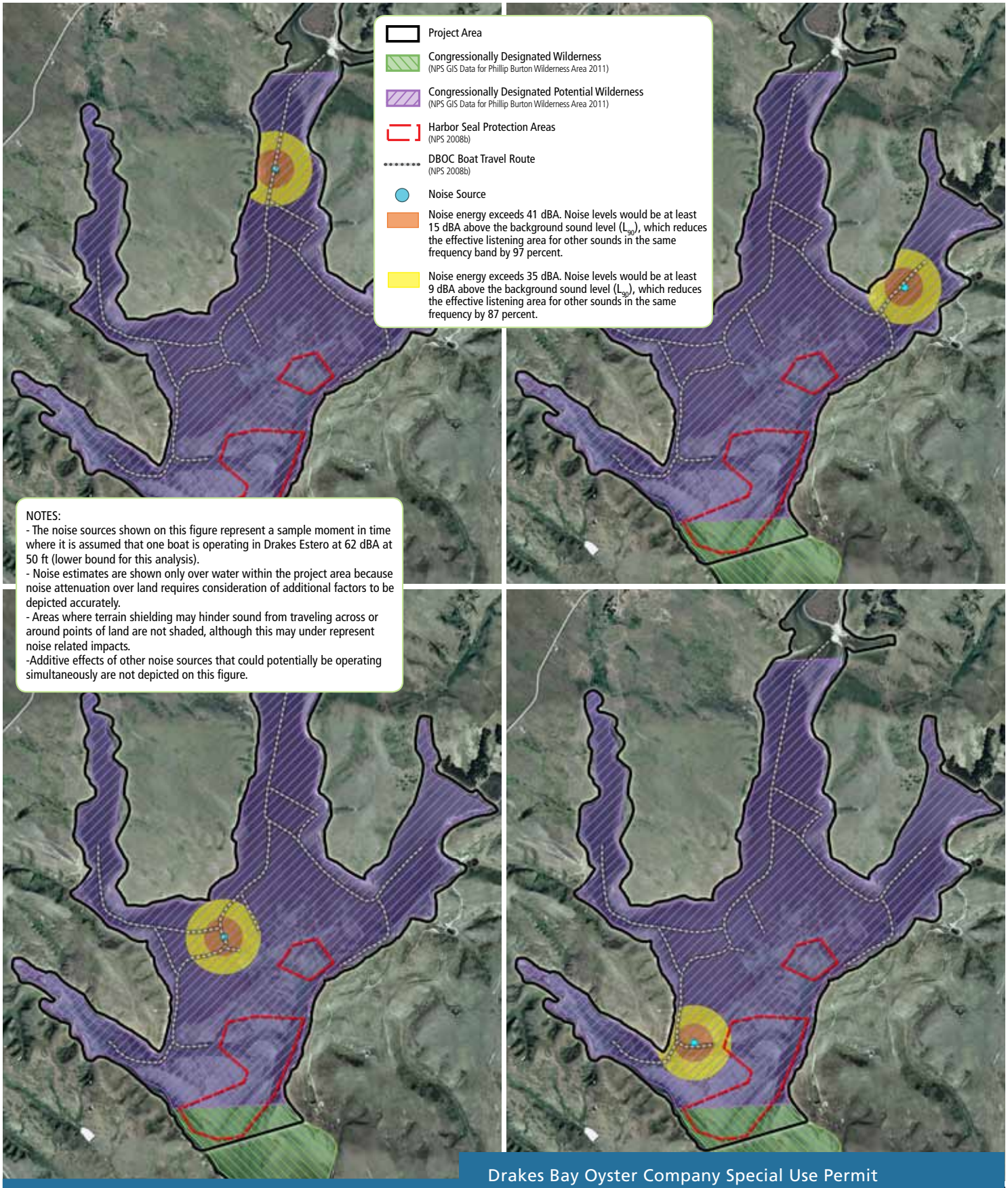

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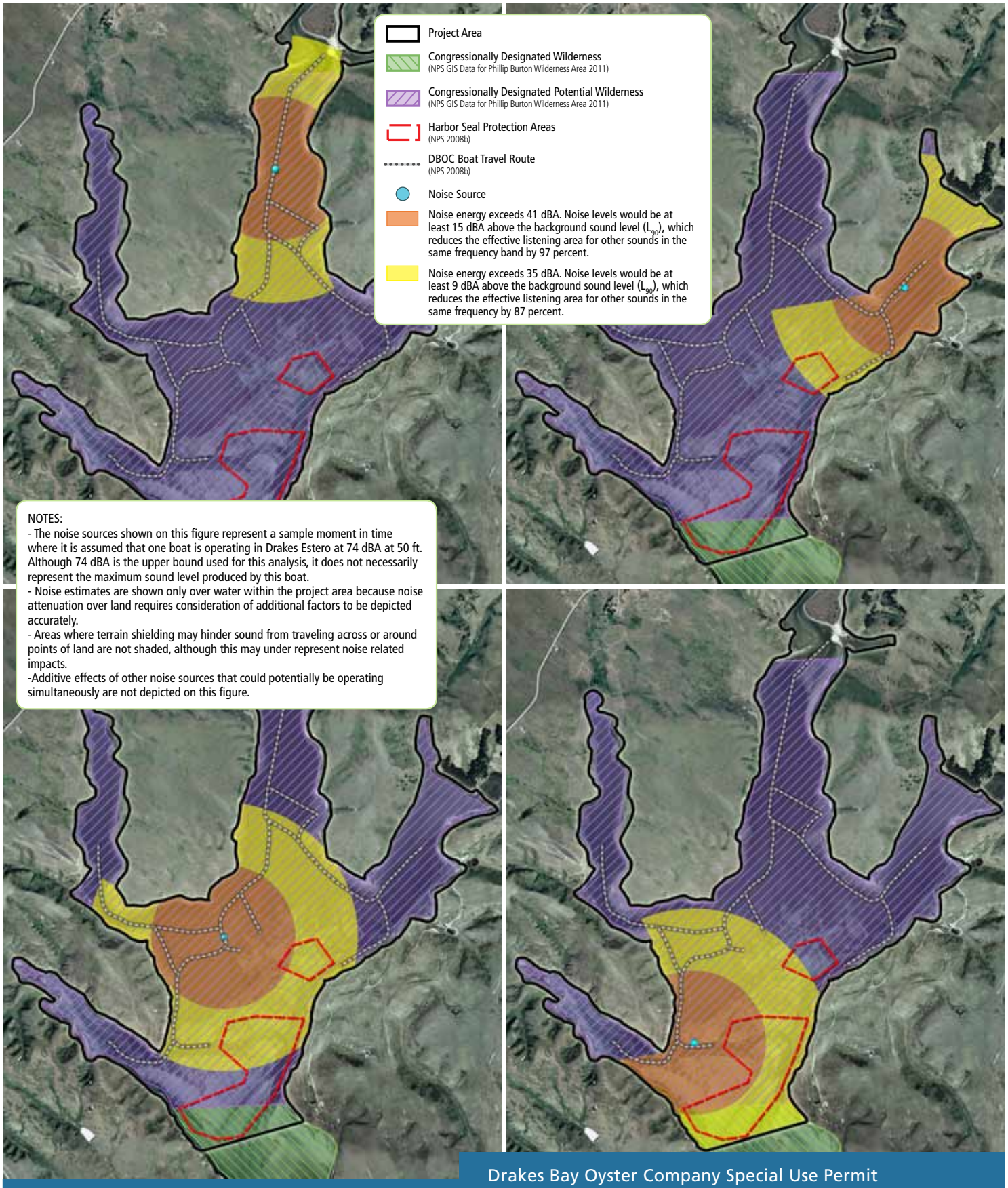
FIGURE 4-3

DBOC Noise Generation - Boat Operations (Lower Bound)



NOTES:
- The noise sources shown on this figure represent a sample moment in time where it is assumed that one boat is operating in Drakes Estero at 74 dBA at 50 ft. Although 74 dBA is the upper bound used for this analysis, it does not necessarily represent the maximum sound level produced by this boat.
- Noise estimates are shown only over water within the project area because noise attenuation over land requires consideration of additional factors to be depicted accurately.
- Areas where terrain shielding may hinder sound from traveling across or around points of land are not shaded, although this may under represent noise related impacts.
-Additive effects of other noise sources that could potentially be operating simultaneously are not depicted on this figure.

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FIGURE 4-4

DBOC Noise Generation - Boat Operations (Upper Bound)

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 would impact the wilderness character 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 in Drakes Estero, and all quantified mechanized equipment in use at the processing station have the potential to project noticeable sounds in the wilderness area at the upper bound of possible noise emissions. 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 (14 to 29 percent) is based on a 24 hour day; noise would impact a much larger percentage of daytime hours. Visitors are allowed to use the kayak parking lot from 6 a.m. to 12 midnight daily, and noise is predicted to be present 19 to 38 percent of time that the site is open to visitor use.

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 perceives noise 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 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 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; Acevedo-Gutierrez and Cendejas-Zarelli 2011). Under alternative B, DBOC operations would continue to cause disturbances related to impacts on the soundscape in 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).

Additional proposed actions have the potential to temporarily contribute to alterations in the natural soundscape. DBOC proposes to repair/replace 50 racks in 2013 and 25 racks in 2014. Although DBOC has not indicated whether or not this would result in additional boat use in Drakes Estero, this analysis assumes that the existing shellfish planting and harvest would occur during the period when racks are under repair, and there would be a short-term increase in boat operations in Drakes Estero to support repair activities. This would likely cause a temporary increase in the duration and spatial dispersion of noise generation in Drakes Estero. Repair and replacement may require more time than required for removal but is assumed to result in interference with the natural soundscape for less than 10 percent of each year (2013 and 2014, respectively). 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). Demolition would interfere with the natural soundscape approximately 2 percent of the year.

Based on the information above, issuance of a 10-year SUP under alternative B would result in long-term major adverse impacts on soundscapes for the additional 10 years of operations, because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape would be interfered with more than 10 percent of the 10-year permit. Additionally, the noise associated with the use of heavy machinery and motorized boats to demolish and reconstruct the dock facilities would be at a level that would cause vocal communication to be difficult at a distance of less than 16 feet. However, temporary impacts (including both rack repair/replacement and dock reconstruction) would interfere with the natural soundscape for less than 10 percent of each year; therefore, alternative B would result in short-term minor to moderate adverse impacts on soundscapes.

Upon expiration of the SUP in 2022, there would be a short-term minor impact during removal and restoration of the shore station habitat, as described in Alternative A. After restoration, noise due to human activities in and around Drakes Estero would decrease dramatically.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact soundscapes in 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 to moderate 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 long-term major adverse impacts on the natural soundscape from continued DBOC operations because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape would be interfered with more than 10 percent of the time. Additionally, the soundscape would be impacted temporarily by demolition and reconstruction of the dock facilities as well as the repair and replacement of racks in Drakes Estero. The noise associated with the use of heavy machinery and motorized boats to demolish and reconstruct the dock facilities and replace and repair the racks would

be at a level that would cause vocal communication to be difficult at a distance of less than 16 feet. However, the impacts associated with these activities would interfere with the natural soundscape for less than 10 percent of each year; therefore, alternative B would result in short-term minor to moderate adverse impacts on soundscapes. The cumulative impact would be long term, major, and adverse, and alternative B would contribute an appreciable adverse 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 on 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 far in excess of 60 dBA at 50 feet. In addition to DBOC trucks and processing station equipment, DBOC would continue to operate its motorboats in potential wilderness, where motorboats are not allowed (except for rare use 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 “Impacts on 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 in and adjacent to Drakes Estero. Actions associated with this alternative that have the potential to impact soundscapes are very similar to those 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. Noise is predicted to be present in Drakes Estero 14 to 29 percent of the 10 year permit, at the same levels as Alternative B.

Based on the information above, issuance of a 10-year SUP under alternative C would result in major adverse impacts on soundscapes for the additional 10 years of operations, because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape would be interfered with more than 10 percent of the 10-year permit. Additionally, the noise associated with the use of heavy machinery and motorized boats to demolish and reconstruct the dock facilities 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 10 percent of each year; therefore, alternative C would result in short-term minor to major adverse impacts on soundscapes.

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 in 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 to moderate 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, issuance of a 10-year SUP under alternative C would result in long-term major adverse impacts on soundscapes for the additional 10 years of operations, because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape is interfered with more than 10 percent of the 10-year permit. Additionally, the soundscape would be impacted temporarily by demolition and reconstruction of the dock facilities as well as the repair and replacement of the racks in Drakes Estero. The noise associated with the use of heavy machinery and motorized boats to demolish and reconstruct the dock facilities and replace and repair the racks would be at a level that would cause vocal communication to be difficult at a distance of less than 16 feet. However, the impacts associated with these activities would interfere with the natural soundscape for less than 10 percent of each year; therefore, alternative C would result in short-term minor to moderate adverse impacts on soundscapes. The cumulative impact would be long term, major, and 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 on 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 substantially in excess of 60 dBA at 50 feet. In addition to the 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 “Impacts on 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 in 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 on average, compared with Alternatives B (600,000 pounds per year on average) and C (500,000 pounds per year on average). This may result in increased operation of the noise-generating equipment described under alternative B, increasing the duration of noise impacts to Drakes Estero; however, during additional design phases of the new onshore development under alternative D, NPS would work with DBOC to ensure that onshore sound-generating equipment would be housed in new buildings constructed or otherwise enclosed to the extent practicable. Due to the lack of specifics available for the proposed improvements, noise levels during operation are assumed to be the same under this alternative as under alternatives B and C, but could potentially be lessened if onshore noise-generating equipment was housed in new buildings, should they be constructed.

Under alternative D, the intensity of temporary impacts described under alternative B would be greater under alternative D due to the more extensive development proposed at the onshore site. Although the final site design is uncertain, there would be some level of demolition of existing structures and construction of new structures in the onshore permit boundaries. The activities associated with this development include onshore use of heavy machinery that typically emit sound levels between 60 and 80 dBA, depending upon which equipment is necessary (FHWA 2006). Activities associated with demolition and construction are assumed to take place over several months, assuming six days per week, 8 hours per day. Due to the level of effort likely required for construction of the new facilities, as currently proposed, this analysis assumes that at least 6 months would be required for demolition and construction. This would interfere with the natural soundscape for more than 10 percent of a year.

Based on the information above, issuance of a 10-year SUP under alternative D would result in major adverse impacts on soundscapes for the additional 10 years of operations, because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape would be interfered with more than 10 percent of the 10 year permit. Additionally, alternative D would also result in short-term major adverse impacts on the natural soundscape due to the use of heavy machinery during development of additional onshore facilities because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape would be interfered with more than 10 percent of the year during which construction would take place.

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 in 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 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 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, issuance of a 10-year SUP under alternative D would result in long-term major adverse impacts on soundscapes for the additional 10 years of operations, because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape is interfered with more than 10 percent of the time. Additionally, the soundscape would be impacted temporarily by demolition and reconstruction of onshore facilities as well as the repair and replacement of racks in Drakes Estero. Alternative D would also result in short-term major adverse impacts on the natural soundscape due to the use of heavy machinery during development of additional onshore facilities because human-caused noise would be at a level (greater than 41 dBA) that requires elevated vocal effort for communication between people separated by 16 feet, and the natural soundscape would be interfered with more than 10 percent of the year during which onshore construction would take place. The cumulative impact would be long term, major, and 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 on 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 substantially in excess of 60 dBA at 50 feet. In addition to the 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 "Impacts on Wilderness."

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 U.S. and to serve as the guiding 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 in the U.S. and its possessions, leaving no lands designated for preservation and protection in their natural condition" (PL 88-577, section 2a). Through this act, Congress announced its intent to preserve and protect wilderness areas in their natural condition.

The NWPS is a nationwide system of wilderness areas. This system currently contains over 700 wilderness areas in 44 of the country's 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 in the Seashore (PL 94-544 and 94-567). This area is known as the Phillip Burton Wilderness Area (PL 99-68). The Phillip 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 immediate congressional wilderness designation. The only nonconforming use in Drakes Estero is DBOC's commercial shellfish operation. PL 94-567 created an administrative mechanism (section 3) allowing NPS to convert the potential wilderness areas in Drakes Estero to full wilderness status once this nonconforming use is removed. When the commercial shellfish operations cease, 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 use of manmade structures. DBOC's commercial shellfish operation, and its associated use of mechanized equipment and manmade infrastructure in Drakes Estero, constitutes a nonconforming use of wilderness.

With regard to nonconforming uses in potential wilderness in the 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 the authority to issue a permit for commercial shellfish operation beyond November 30, 2012 (DOI 2004). At that time, NPS notified CDFG of this information (NPS 2004d[lx]), and CDFG notified JOC (CDFG 2004a[lxi]). 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 a period of 10 years, until November 30, 2022.

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).

Any action proposed to take place in wilderness related to 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; wilderness.net 2011) 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 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

Negligible:	The impact is not detectable or measurable.
Minor:	Impacts on qualities of wilderness character would occur and would be highly localized in the wilderness portion (including both the congressionally designated wilderness and congressionally designated potential wilderness) of the project area.
Moderate:	Impacts on qualities of wilderness character would be readily apparent in the wilderness portion (including both the congressionally designated wilderness and congressionally designated potential wilderness) of the project area.
Major:	Impacts on qualities of wilderness character would be readily apparent and widespread throughout the wilderness portion (including both the congressionally designated wilderness and congressionally designated potential wilderness) of the project area.

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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

DBOC operations currently represents the only nonconforming structures and uses in the 1,363 acres of congressionally designated wilderness in Drakes Estero. Cessation of these uses by November 30, 2012 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.

Removal of bags, racks, and associated shellfish infrastructure from approximately 142 acres of Drakes Estero and would cease the use of motorboats in 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.

The cessation of commercial shellfish operations would eliminate the most apparent effect of modern civilization from in Drakes Estero. Removal of cultured shellfish and associated 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). 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). Research shows that 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 in 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.

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), commercial shellfish operations increase the availability of hard substrate for colonization by tunicate in Drakes Estero. The termination of DBOC activities would greatly reduce the potential for shellfish cultivation-related propagation of nonnative species such as colonial tunicates, which take advantage of the substrate created by the shellfish operation 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 shellfish operations; 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 continued motorboat use (approximately 8.5 miles of estimated damage in 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. Cleanup of shellfish operation-related debris could take

place. There would be no risk of increased contribution from ongoing commercial shellfish operations. 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 shellfish operations would no longer disturb wildlife in the project area. As discussed in greater detail under the impact topic of soundscapes, pneumatic drills and oyster tumblers are used by DBOC staff for approximately 2 hours per day near the dock. DBOC's pneumatic drills are estimated to produce sound levels between 67 and 80 dBA at 50 feet. Use of drills at these levels could take between 0.4 miles (2,071 feet) and 1.4 miles (7,537 feet) for the noise to decrease to the ambient sounds level (34 dBA). Detail related to soundscapes is provided in the "Impacts on Soundscapes" section of this chapter. 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; Acevedo-Gutierrez and Cendejas-Zarelli 2011). 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). 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.

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 through the removal of racks, resulting in a readily apparent, widespread improvement in wilderness character.

Removal of structures and motorboats in Drakes Estero would enhance opportunities for solitude in Drakes Estero, allowing visitors to enjoy a primitive and unconfined form of recreation. Many visitors kayak (or use other types of nonmotorized boats) in Drakes Estero. Under this alternative, opportunities for solitude and primitive recreation would no longer be interrupted by DBOC's daily motorboat use (approximately 12 trips per day, six days per week) or the visual disturbance to the natural scene associated with the presence of shellfish operation-related structures such as racks or debris such as plastic spacers. 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.

There are a number of approaches to remove the racks, ranging from import of a small barge with hydraulic lift to pull the posts to deconstruction using existing barge and boats. While most of the removal activities would be manual, mechanized boats would be required for the duration of the removal activities. Use of these boats would be subject to minimum requirement and minimum tool analysis. Use

of motorized craft to remove the racks would temporarily (lasting 2 to 3 months) impact the ability of Drakes Estero to offer an outstanding opportunity for solitude. Visitors wishing to enjoy a primitive and unconfined form of recreation would be disturbed during the duration of rack removal.

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 ongoing maintenance of these facilities would support continued access by Seashore 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.

Common to all alternatives, baseline surveys and monitoring of resources would occur to assist with identifying the extent and distribution of target resources including benthic and infaunal communities (tunicates, Manila clams, Olympia oyster, etc.) and eelgrass. These surveys and results of monitoring would provide site-specific data and lead to a better understanding of the natural ecological processes in Drakes Estero, thus improving long-term management of Drakes Estero.

NPS currently prohibits other Seashore visitors from using mechanized boats and equipment in 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). Since DBOC's commercial shellfish operation is the only nonconforming use in Drakes Estero, 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 in 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.

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. Alternative A would also result in short-term minor adverse impacts on wilderness because removal of racks would detract from offering outstanding opportunities for solitude in highly localized areas of the congressionally designated wilderness in Drakes Estero.

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

Cumulative Impact Analysis

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

Planning and management activities may authorize the use of motorboats in Drakes Estero for research or administrative purposes. Motorboat use in 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 in 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 Phillip Burton Wilderness in 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. In 2009, removal of Glenbrook Dam from the Glenbrook portion of Estero de Limantour resulted in removal of a nonconforming structure in the existing wilderness area. Removal of nonconforming structures 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. Recreational clamming has the potential to disrupt sediment and impact benthic fauna habitat on mudflats and sandbars. Such disruption imposes human manipulation on resources in the wilderness, but because such an activity is known to take place only occasionally, no noticeable change in the ecosystem would take place. Therefore, the untrammeled quality of wilderness may be somewhat diminished; however, because members of the public who want to clam in Drakes Estero would have to do so without the use of mechanized equipment, such a use would not prevent conversion of congressionally designated potential wilderness to congressionally designated wilderness.

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 the 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 the removal of a commercial shellfish operation that detracts from wilderness character, including:

- removal of nonnative shellfish cultivation (approximately 585,000 pounds in 2010); this equates to approximately 6 million oysters
- removal of human-made infrastructure associated with commercial shellfish operations, including 5 miles (7 acres) of racks and up to 88 acres of bottom bags in up to 142 acres of Drakes Estero
- discontinuation of motorboat operations, including use of 2-3 motorboats intermittently 8 hours per day, 6 days per week, covering approximately 740 acres of Drakes Estero; and discontinuation of ongoing eelgrass impacts similar to the 8.5 miles of linear propeller scarring as documented in the “Impacts on Eelgrass” section
- discontinuation of noise sources associated with commercial operation affecting wilderness

Alternative A would also result in short-term minor adverse impacts on wilderness because activities related to the removal of racks would detract from offering outstanding opportunities for solitude in highly localized areas of the congressionally designated wilderness in Drakes Estero. 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 in 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 in 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 motorized 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 and Manila clams
  - Permit Area 2: Purple-hinged rock scallops

The presence of DBOC's commercial shellfish operations, including continued cultivation of nonnative shellfish and maintenance of shellfish-related structures and materials and motorboats in Drakes Estero, would perpetuate the conditions that adversely impact wilderness characteristics and experiences in Drakes Estero. It also would result in 10 more years of nonconforming uses in 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.

Under alternative B, DBOC's bags, racks, and associated shellfish infrastructure would remain 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.

Under alternative B, DBOC operations would impose a number of changes on the native species composition and habitat availability in 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. Assuming 100 percent production of oysters, this could result in approximately 7.06 million individual shellfish being harvested annually. 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, and the risk of shellfish operation debris being released into 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 in 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 in 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.

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. 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 in Drakes Estero. Many visitors kayak or use other types of nonmotorized boats (such as canoes), a primitive and unconfined form of recreation, in Drakes Estero. Noise from both motorboats and onshore operations would detract from the opportunities for solitude for these visitors. DBOC's continued maintenance of nonnative shellfish and shellfish infrastructure and any fugitive debris in 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 this alternative, DBOC would repair/replace 50 of the racks in 2013 and another 25 racks in 2014 (DBOC 2012b[lxii]). Although DBOC has not indicated whether additional boat use would be required to conduct these repairs, this may be the case. This proposal would replace and repair human-made structures in congressionally designated potential wilderness. The continued maintenance of structures for commercial use may further inhibit the ability of Drakes Estero to provide outstanding opportunities for solitude or primitive and unconfined recreation in the short term.

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 continued maintenance of these facilities would support continued access by Seashore 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 in Drakes Estero; however, such use would continue to be subject to a minimum requirement analysis, as described under alternative A.

NPS currently prohibits Seashore visitors from using mechanized boats and equipment in 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 Seashore 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 in 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 in 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 in 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 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 the conversion of Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. The elements of DBOC's commercial shellfish operation that detract from wilderness character include

- continued cultivation of nonnative shellfish (up to 600,000 pounds per year, otherwise expressed as approximately 7.06 million oysters annually)
- continued maintenance of human-made infrastructure associated with commercial shellfish operations, including 5 miles of racks and up to 84 acres of bottom bags in up to 138 acres of Drakes Estero
- continued operation of 2-3 motorboats intermittently 8 hours per day, 6 days per week, covering approximately 740 acres of Drakes Estero; ongoing eelgrass impacts similar to the 8.5 miles of linear propeller scarring documented in "Impacts on Eelgrass"
- continued generation of noise sources associated with commercial shellfish operations affecting wilderness (emanating from both inside and outside wilderness)

The cumulative impact would be long term, major, and 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 in 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 in 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 in 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
  - Permit Area 2: 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 removed from all growing areas under alternative C, minimizing the potential for this nonnative species to become established in Drakes Estero and use resources that would otherwise be available to native bivalves and other benthic fauna. 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). DBOC would be responsible for modifying current harvest and distribution practices to minimize potential for *Didemnum* to spread to other areas in Drakes Estero through fragmentation.

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 in 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 in 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 in 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 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 the conversion of Drakes Estero from congressionally designated potential wilderness

to congressionally designated wilderness. The elements of DBOC's commercial shellfish operation that detract from wilderness character include

- continued cultivation of nonnative shellfish (up to 500,000 pounds per year, otherwise expressed as approximately 5.88 million oysters annually)
- continued maintenance of human-made infrastructure associated with commercial shellfish operations, including 7 miles of racks and up to 84 acres of bottom bags in up to 138 acres of Drakes Estero
- continued operation of 2-3 motorboats intermittently 8 hours per day, 6 days per week, covering approximately 740 acres of Drakes Estero; ongoing eelgrass impacts similar to the 8.5 miles of linear propeller scarring documented in "Impacts on Eelgrass"
- continued generation of noise sources associated with commercial shellfish operations affecting wilderness (emanating from both inside and outside wilderness)

The cumulative impact would be long term, major, and 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 in 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 in 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 in 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, 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, 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 in 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. DBOC also proposes to gather swimming larvae of native species (i.e., Olympia oyster and purple-hinged rock scallops) from Drakes Estero under this alternative. The increased potential for cultivation of species that are native to the California coast could result in 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; however, capture and cultivation of larvae would impose modern human control over the natural ecosystem.

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 in 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 in 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 in 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 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 the conversion of Drakes Estero from congressionally designated potential wilderness to congressionally designated wilderness. The elements of DBOC's commercial shellfish operation that detract from wilderness character include

- continued cultivation of nonnative shellfish (up to 850,000 pounds per year, otherwise expressed as approximately 10 million oysters annually)
- continued maintenance of human-made infrastructure associated with commercial shellfish operations, including 7 miles of racks and up to 84 acres of bottom bags in up to 138 acres of Drakes Estero
- continued operation of 2-3 motorboats intermittently 8 hours per day, 6 days per week, covering approximately 740 acres of Drakes Estero; ongoing eelgrass impacts similar to the 8.5 miles of linear propeller scarring documented in "Impacts on Eelgrass"
- continued generation of noise sources associated with commercial shellfish operations affecting wilderness (emanating from both inside and outside wilderness)

The cumulative impact on wilderness would be long term, major, and 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 in 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 in Drakes Estero would substantially detract from the wilderness characteristics of Drakes Estero for an additional 10 years. Collection of larvae is considered and analyzed as part of this alternative; however, DBOC's proposal to collect native shellfish larvae in Drakes Estero would not be consistent with the NPS mission, per *Management Policies 2006* (NPS 2006d), or regulations.

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, section5 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. . Visitor services, as defined by NPS, must be consistent, to the highest practicable degree, with the preservation and conservation of the resources and values of the unit (16 USC5951[b]; 16 USC 5952; 36 CFR 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

The area of analysis for visitor experience and recreation is the boundary of the Seashore. This section summarizes the impacts on visitor experience and recreation from the actions that would potentially occur in the area of analysis under each alternative. The potential for changes to the visitor experience and recreation 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. As described later in this section, DBOC estimates that approximately 50,000 people visit the oyster company annually (DBOC 2010n[lxiii]), composing approximately 2.5 percent of the annual visitors to the Seashore (NPS 2011a). Specific data regarding the percentage of DBOC visitors who travel to the Seashore solely to visit the oyster company are not available; however, due to the proximity of other Seashore resources along Sir Francis Drake Boulevard, it is assumed that many of the annual visitors to DBOC also visit other areas of the Seashore during their trip. Visitors to the Seashore have a wide variety of interests that cannot be categorized into one group. Therefore, this section acknowledges that impacts associated with each alternative could be both beneficial and adverse. Specific impacts associated with each alternative are described below. 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

Negligible:	The impact is not detectable or measurable and would not affect visitors.
Minor:	Impacts on visitor experience and recreation would be detectable and would affect a small portion of Seashore visitors.
Moderate:	Impacts on visitor experience and recreation would be readily apparent and would affect many Seashore visitors.
Major:	Impacts on visitor experience and recreation would be readily apparent and would affect the majority of Seashore visitors.

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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The termination of the existing commercial shellfish operation and removal of associated personal property from the site would provide visitors with a more natural experience in the project area. In particular, as illustrated in the photographic simulations below, the removal of shellfish operation-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 and would eliminate the source of commercial shellfish operation-related debris that may wash up on surrounding beaches and shorelines. Photographic simulations provide visual examples of the project area before (existing conditions) and after (alternative A) the removal of DBOC onshore and offshore facilities and structures. Actual conditions following removal are predicted based on the surrounding area. Future conditions may vary somewhat from the depicted image.

Left: View of existing onshore DBOC facilities facing north, taken during February 2011 site visit. (Photograph courtesy of VHB.)

Right: Photographic simulation of conditions along the eastern shoreline of Schooner Bay (looking north) (the same view as the photograph to the left) following the removal of DBOC facilities under alternative A.

Left: View of existing oyster rack in Drakes Estero used by DBOC for Japanese hanging culture, as seen at low tide (during high tide, only the top of the racks—the stringers—are visible). (Photograph courtesy of NPS.)

Right: Photographic simulation of the same view of Drakes Estero, following the removal of DBOC facilities under alternative A.

Left: View of DBOC bottom bag culture methods used by DBOC for clams and oysters. Photograph was taken during a 2009 low tide (during high tide, bags may be submerged). (Photograph courtesy of NPS.)

Right: Photographic simulation of the same view of Drakes Estero following the removal of DBOC facilities under alternative A.

The cessation of DBOC operations also would eliminate smell and sound disturbances associated with commercial shellfish operations. The recreational use of motorboats in Drakes Estero would continue to be prohibited because of the congressional wilderness designation. In addition, radios would no longer be used by DBOC staff in the project area to listen to music. As such, visitors would be provided an opportunity for solitude and a primitive or unconfined type of recreation, a hallmark of a wilderness experience. As such, alternative A would have a beneficial impact on the visitor experience and recreation for those seeking a natural park experience in Drakes Estero.

DBOC estimates that approximately 50,000 people visit the oyster company annually (DBOC 2010n[lxiv]), composing approximately 2.5 percent of the approximately 2 million annual visitors to the Seashore (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, due to the proximity of other Seashore resources along Sir Francis Drake Boulevard, it is likely that many of the annual visitors to DBOC also visit other areas of the

Seashore during their trip. The primary focus of DBOC is the commercial operation for the sale of shellfish to restaurants and the wholesale shellfish market outside the Seashore. These are not commercial services being offered to the visiting public to further the public's use and enjoyment of the Seashore as a whole. However, according to DBOC, the operation offers visitors an experience that is not afforded elsewhere in the Seashore (DBOC 2011i[lxv]). Based on information provided by DBOC, as described in chapter 3, these experiences include opportunities to

- purchase and eat fresh oysters on site
- learn about the history of agriculture and shellfish operations in the Seashore, the benefits of oysters (both as a food source and in the coastal ecosystems), and sustainable shellfish operations (Cummings 2011[lxvi]; DBOC 2010r[lxvii]; DBOC 2011i[lxviii]).

Other area shellfish operations, such as the Tomales Bay Oyster Company and Hog Island Oyster Company, which offer similar experiences, have indicated that they are operating at capacity (with respect to visitation) and do not anticipate they could accommodate an increase in visitors due to the loss of DBOC (Tomales Bay Oyster Company 2011[lxix]; Hog Island Oyster Company 2011[lxx]). Therefore, the termination of commercial shellfish operations in Drakes Estero could adversely affect the experience for visitors interested in commercial shellfish operations and the recreational opportunities offered by DBOC. However, if the demand for such an experience is great enough after the closure of DBOC, it is likely that the market would adapt to meet these demands.

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 nonmotorized boat access to the water during this period, but would allow visitors to access Drakes Estero on foot. 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. 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, overall, alternative A would result in a long-term beneficial or long-term minor adverse impact on visitor experience and recreation, depending on the interests of the particular visitor. The termination of commercial shellfish operations in Drakes Estero would enhance the visitor enjoyment of marine wilderness resources, but would eliminate an opportunity for the 2.5 percent of Seashore visitors, a small portion of the total Seashore visitation, who are interested in experiencing a commercial shellfish operation in the Seashore.

Cumulative Impact Analysis

Past, present, and reasonably foreseeable future actions have the potential to impact visitor experience and recreation in the project area. These actions include kayaking and 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 in Drakes Estero. Of those authorized, only 3 provided kayak tours of Drakes Estero in 2010, accommodating a total of 221 visitors (NPS 2010g). If commercial shellfish operations are terminated in Drakes Estero, authorized kayak tour operators may choose to expand its tours in Drakes Estero. Additional commercial operators also may apply for commercial use authorization in the Seashore. This would provide more visitors with the opportunity to experience kayaking in the Seashore and enjoy the surrounding landscape from in Drakes Estero. Ongoing commercial kayak tours as well as ongoing private kayaking in Drakes Estero would result in a long-term beneficial impact on visitor experience and recreation in 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 in 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 and beneficial. The beneficial impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial or long-term minor adverse impacts of alternative A, would result in long-term beneficial or long-term minor adverse cumulative impacts on visitor experience and recreation in the project area. Alternative A would contribute an appreciable beneficial or noticeable adverse increment to the cumulative impact on visitor experience and recreation.

Conclusion

Overall, alternative A would result in a long-term beneficial or long-term minor adverse impact on visitor experience and recreation, depending on the interests of the visitor. From the perspective of visitors seeking a natural park experience in Drakes Estero, alternative A would be beneficial because it would increase these opportunities. Alternative A would maintain visitor access to Drakes Estero, limiting access to recreational boaters only during the annual seal pupping season (March 1 to June 30). As described above, those looking to experience an active commercial shellfish operation would be adversely impacted by alternative A because they would no longer have this opportunity in the Seashore. The latter group of visitors composes up to 2.5 percent of the total visitors to the Seashore. Therefore, at a Seashore-wide scale, the adverse impacts associated with this alternative would affect a small portion of Seashore visitors. The cumulative impact would be long term and beneficial or long term, minor, and adverse, and alternative A would contribute an appreciable beneficial or noticeable adverse increment to the overall cumulative impacts.

With respect to visitor experience and recreation, alternative A would be consistent with relevant law and policy because the 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 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would have the potential to impact visitor experience and recreation include:

- continued tours of DBOC onshore 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 (including the repair/replacement of 50 racks in 2013 and 25 racks in 2014)
- continued motorized boat traffic

DBOC would continue to offer interpretive tours of its onshore facilities (focused on the history of and process associated with shellfish operations in Drakes Estero) and would 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. From the perspective of visitors interested in such an opportunity, alternative B would have a beneficial impact on visitor experience and recreation for an additional 10 years.

Continued DBOC operations related to shellfish production may disrupt the recreational experience desired by some visitors to the Seashore, in particular those visitors seeking a natural park experience, including those looking to experience 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 in Drakes Estero, would perpetuate the conditions that adversely impact the wilderness qualities and experiences in 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 commercial shellfish operations in Drakes Estero and the presence of associated structures may be viewed as 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). This debris would also continue to wash up on the surrounding shoreline and on beaches. Visitors to Drakes Estero, including hikers and kayakers may experience sights, smells, or sounds associated with routine shellfish harvest and onshore processing operations, which may detract from the natural surroundings. In addition to the visual intrusions, these odors detract from visitor enjoyment of the natural surroundings.

Under this alternative, as detailed in chapter 2, DBOC would repair/replace 50 racks in 2013 and another 25 racks in 2014 (DBOC 2012b[lxxi]). Following the initial wide-scale repairs (to approximately 75 percent of the racks), regular maintenance is proposed (DBOC 2012b[lxxii]). NPS estimates that repair and replacement would be minimal with approximately 1,000 to 2,000 linear feet of lumber installed annually and a limited number of vertical posts replaced as necessary. Repair and replacement activities would temporarily increase disruptions to the visitor experience in Drakes Estero, both for DBOC visitors and those visitors seeking a natural park experience.

Alternative B would not noticeably change the visitor experience in 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 the anticipated conditions under the no-action alternative.

Overall, alternative B would result in a short-term, minor adverse impact and a long-term minor adverse or long-term beneficial impact on visitor experience and recreation for another 10 years, depending on the particular interests of the visitor. The adverse impact on visitors seeking a natural park experience would be readily apparent in Drakes Estero (the primary resource area), but only those visitors to the Seashore seeking a natural experience in Drakes Estero would be affected. The impacts would somewhat inhibit visitor enjoyment of marine wilderness resources, but would only affect a small portion of visitors, those seeking a natural park experience in Drakes Estero. The impact on visitors seeking to experience commercial shellfish operation and associated recreational opportunities in Drakes Estero would be beneficial because DBOC would continue to offer fresh oysters and educational experiences and services in Drakes Estero.

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 on visitor experience and recreation in the project area. Commercial shellfish operations would cease in 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 in 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 minor adverse or long-term beneficial impacts of alternative B, would result in long-term minor adverse or long-term beneficial impacts on visitor experience and recreation. Alternative B would contribute a noticeable adverse or appreciable beneficial increment to the cumulative impact.

Conclusion

Overall, alternative B would result in short-term minor adverse impacts as well as long-term minor adverse or long-term beneficial impacts on visitor experience and recreation in the project area for an additional 10 years, depending on the interests of the visitor. Impacts from continued commercial shellfish operations in Drakes Estero (the primary resource area) would be detectable and would affect a small portion of visitors to the Seashore. In particular, from the perspective of those seeking a natural park experience in Drakes Estero, including those interested in experiencing solitude and a primitive, unconfined type of recreation, the impacts would somewhat inhibit visitor enjoyment of marine wilderness resources. Visual and sound disturbances associated with commercial shellfish operations would continue in the project area and would be particularly adverse for visitors looking to enjoy solitude and a primitive or unconfined type of recreation in 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, and DBOC staff would continue to operate radios to listen to music while working, both of which would detract from the natural soundscapes of the Seashore. The smell of motorized boats and routine shellfish processing operations would also detract from the natural environment. Visitors to the Seashore who are interested in experiencing an active commercial shellfish operation would consider alternative B to have a beneficial impact because DBOC would continue to offer experiences such as educational tours and services and fresh oysters to visitors. The cumulative impact would be long term, minor, and adverse or long-term and beneficial, and alternative B would contribute a noticeable adverse or appreciable beneficial increment to the cumulative impact. In the short term, the repair and replacement of 50 racks in 2013 and another 25 racks in 2014, followed by regular maintenance, would temporarily increase disruptions to the visitor experience in Drakes Estero, both for visitors to the Seashore and DBOC visitors.

With respect to visitor experience and recreation, this alternative would 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 USC 5951[b]; 16 USC 5952; 36 CFR 51.3 [definition of “visitor service”]). The primary focus of DBOC is the commercial operation for the sale of shellfish to restaurants and the wholesale shellfish market outside the Seashore. These are not commercial services being offered to the visiting public to further the public’s use and enjoyment of the Seashore. Therefore, DBOC’s operations would not be 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would 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 a picnic area in the vicinity. Therefore, alternative C would result in minimal changes to the overall visitor experience in the project area 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 short-term minor adverse impact and a long-term minor adverse or long-term beneficial impact on visitor experience and recreation in the Seashore for an additional 10 years, depending on the interests of the particular visitor. The impact on visitors seeking a natural park experience, including those seeking solitude and a primitive, unconfined type of recreation, would be readily apparent in Drakes Estero (the primary resource area), but only a small portion of all visitors the Seashore (those seeking a natural experience in Drakes Estero) would be affected. From the perspective of these visitors, continued commercial shellfish operations in Drakes Estero would somewhat inhibit visitor enjoyment of the resources for which the Seashore was established. In contrast, visitors seeking to experience an active commercial shellfish operation would benefit from this alternative because DBOC would continue to offer such an opportunity.

In the short-term, the repair/replacement of 50 racks in 2013 and another 25 racks in 2014, followed by regular maintenance, would temporarily increase disruptions to the visitor experience in Drakes Estero, both for visitors to the Seashore and DBOC visitors.

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 on 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 in 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 and beneficial. The impacts of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse or long-term beneficial impacts of alternative C, would result in a long-term minor adverse or long-term beneficial cumulative impact on visitor experience and recreation. Alternative C would contribute a noticeable adverse or appreciable beneficial increment to the cumulative impact.

Conclusion

Overall, alternative C would result in short-term minor adverse and long-term minor adverse or long-term beneficial impact on visitor experience and recreation in the project area for an additional 10 years, depending on the interests of the particular visitor. Continued commercial shellfish operations in Drakes Estero (the primary resource area) would be detectable at the Seashore scale and would affect a small portion of visitors to the Seashore. Specifically, from the perspective of those seeking a natural park

experience in Drakes Estero, including those looking to experience solitude and a primitive, unconfined type of recreation, the impacts would somewhat inhibit visitor enjoyment of the 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, located adjacent to the retail area and away from the shoreline, would be removed and would be replaced by NPS with another picnic area nearby. Visual and sound disturbances associated with commercial shellfish operations would be apparent in the project area, although the associated impacts would be mostly limited to those visitors looking to enjoy a natural park experience in Drakes Estero. 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. This debris also would continue to wash up on surrounding shorelines and beaches. In addition, motorized boats would continue to operate in Drakes Estero, and DBOC staff would continue to operate radios to listen to music, both of which would detract from the natural soundscapes of the Seashore. The smell of motorized boats and routine shellfish processing operations also would detract from the natural environment. Visitors to the Seashore who are interested in experiencing an active commercial shellfish operation would consider alternative C to have a beneficial impact because DBOC would continue to offer visitor experiences such as educational tours and services and fresh oysters. The cumulative impact would be long term, minor, and adverse or long-term and beneficial, and alternative C would contribute a noticeable adverse or appreciable beneficial increment to the cumulative impact.

In the short term, the repair and replacement of 50 racks in 2013 and another 25 racks in 2014, followed by regular maintenance, would temporarily increase disruptions to the visitor experience in Drakes Estero, both for visitors to the Seashore and DBOC visitors.

With respect to visitor experience and recreation, alternative C would 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 USC 5951[b]; 16 USC 5952; 36 CFR 51.3 [definition of “visitor service”]). The primary focus of DBOC is the commercial operation for the sale of shellfish to restaurants and the wholesale shellfish market outside the Seashore. These are not commercial services being offered to the visiting public to further the public’s use and enjoyment of the Seashore. Therefore, DBOC’s operations would not be 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would have the potential to impact visitor experience and recreation are the same as those described under alternative B, with a few exceptions. Differences from alternative B that would have the potential to impact visitor experience and recreation include:

- increased production limits
- 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 in 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 in Drakes Estero would not be consistent with the NPS requirements for interpretive services, as described in the NPS *Management Policies 2006* (NPS 2006d). Nonetheless, some visitors to the Seashore enjoy the experiences offered at DBOC, including the opportunity to learn about the history of shellfish operations in Drakes Estero. 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[lxxiii]). 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[lxxiv]). 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[lxxv]). From the perspective of those interested in visiting an active shellfish operation, this alternative would have a beneficial impact on visitor experience and recreation in the project area for 10 years. The benefits of alternative D also would be slightly greater than alternatives B and C due to the additional interpretive opportunities that would be available.

Construction activities associated with this alternative could result in adverse impacts on visitor experience and recreation in Drakes Estero for both Seashore visitors seeking a natural experience and DBOC visitors. In particular, such activities could further disturb soundscapes and views in Drakes Estero and could temporarily limit interpretive and educational experiences at DBOC.

Expanded and improved opportunities for those interested in learning more about commercial shellfish production at the site may result in a slight increase in visitors at the site; however, that is not expected to noticeably affect traffic flows in the area of analysis or access to the Coast Guard Communications Area Master Station Pacific (CAMSPAC) facility. Additional studies would be required to determine the effects of potential change on DBOC visitation and associated traffic conditions.

Continued, expanded shellfish production at DBOC may disrupt the recreational experience desired by some visitors to the Seashore, in particular those visitors seeking a natural park experience in Drakes Estero, including those looking to experience 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 in Drakes Estero, including related structures and materials and motorized boats, would perpetuate the conditions that adversely impact the wilderness qualities and experiences in 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, continued motorized boat traffic would likely increase. During DBOC's redevelopment of the site, the 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. Construction activities also could require DBOC to temporarily limit its interpretive and educational services.

Overall, alternative D would result in a short-term moderate adverse impact and long-term minor adverse or long-term beneficial impact on visitor experience and recreation in the project area for an additional 10 years, depending on the interests of the particular visitor. The impact on visitors seeking a natural park experience would be readily apparent in Drakes Estero (the primary resource area), but only a small portion of the total number of visitors to the Seashore would be affected. From the perspective of those seeking a natural park experience in Drakes Estero, the impacts would somewhat inhibit visitor enjoyment of marine wilderness resources. Visitors to the Seashore who are interested in experiencing an active commercial shellfish operation would consider alternative D to have a beneficial impact because DBOC would continue to offer visitor experiences such as educational tours and services and fresh oysters. The benefits associated with this alternative would be slightly enhanced, in comparison to alternatives B and C because alternative D would facilitate expanded interpretation and educational opportunities at DBOC. During construction, alternative D also would result in short-term moderate adverse impacts on visitor experience and recreation for both groups of visitors. Construction vehicles and equipment could further disturb soundscapes and views in Drakes Estero and could temporarily limit some interpretive and educational services at DBOC. The repair/replacement of 50 racks in 2013 and another 25 racks in 2014, followed by regular maintenance, also would temporarily increase disruptions to the visitor experience in Drakes Estero, both for visitors to the Seashore and DBOC visitors.

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 on 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 in 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, 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 and beneficial. The impacts of past, present, and reasonably foreseeable future actions, when combined with the long-term minor adverse or long-term beneficial impacts of alternative D, would result in a long-term minor adverse or long-term beneficial cumulative impact on visitor experience and recreation. Alternative D would contribute a noticeable adverse or appreciable beneficial increment to the cumulative impact.

Conclusion

As described above, alternative D would result in short-term moderate adverse as well as long-term minor adverse or long-term beneficial impacts on visitor experience and recreation in the project area for an additional 10 years, depending on the interests of the particular visitor. Continued commercial shellfish operations in Drakes Estero (the primary resource area) would be detectable at the Seashore scale and would affect a small portion of visitors to the Seashore. In particular, from the perspective of those seeking a natural park experience, the impacts would somewhat inhibit visitor enjoyment of marine wilderness resources. Similar to alternatives B and C, visual and sound disturbances associated with commercial shellfish operations could be readily apparent in the project area, and this impact would be particularly adverse for visitors seeking a natural park experience in Drakes Estero. Visual and sound disturbances associated with commercial shellfish operations would continue in the project area, and would be particularly adverse for visitors looking to enjoy solitude and a primitive or unconfined type of recreation in 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, and DBOC staff would continue to use radios to listen to music, both of which would detract from the natural soundscapes of the Seashore. The smell of motorized boats and routine shellfish processing operations also would detract from the natural environment. 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 other items associated with shellfish operations in Drakes Estero. Visitors to the Seashore who are interested in experiencing an active shellfish operation may consider alternative D to have a greater beneficial impact on visitor experience and recreation than the other alternatives because under this alterative the new facilities would enhance interpretation and educational opportunities at DBOC. However, in the short term, construction activities associated with alternative D could result in adverse impacts on visitor experience and recreation in Drakes Estero for both types of visitors. In particular, such activities could further disturb soundscapes and views in Drakes Estero and could temporarily limit interpretive and educational experiences at DBOC. In addition, the repair and replacement of 50 racks in 2013 and another 25 racks in 2014, followed by regular maintenance, also would temporarily increase disruptions to the visitor experience in Drakes Estero, both for visitors to the Seashore and DBOC visitors. The cumulative impact on visitor experience and recreation would be long term, minor, and adverse or long term and beneficial, and alternative D would contribute a noticeable adverse and appreciable beneficial increment to the cumulative impact.

With respect to visitor experience and recreation, alternative D would 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 USC 5951[b]; 16 USC 5952; 36 CFR 51.3 [definition of “visitor service”]. The primary focus of DBOC is the commercial operation for the sale of shellfish to restaurants and the wholesale shellfish market outside the Seashore. These are not commercial services being offered to the visiting public to further the public's use and enjoyment of the Seashore. Therefore, DBOC’s operations would not be 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, where DBOC is located, 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 and statewide scale, the socioeconomic analysis evaluates impacts on the Inverness Census Designated Place (Inverness CDP), which is in Marin County. As the nearest municipality to the project area, socioeconomic data from Inverness CDP best reflects the conditions in the project area and offers an appropriate comparison to overall Marin County data. Specifically, impacts on the shellfish market are evaluated at a statewide scale while other socioeconomic resources considered in this section are discussed in terms of Inverness CDP and/or the county. This is because shellfish operations are dispersed throughout California and not concentrated in one county or region. Therefore, evaluating operations at a scale smaller than the state level would distort the role of that operation in the larger market. In addition, much of the available data related to the shellfish market is provided at a state level. Shellfish data at the county level is presented in this section for reference purposes only and is not considered to be representative of the larger market. 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 (CDFG 2011a, 2011c, 2011e, and CDFG [Ramey] pers. comm 2011d), the Pacific Coast Shellfish Growers Association (PCSGA 2009), and an independent survey of the California shellfish industry prepared by Ted Kuiper (Kuiper 2009). CDFG has acknowledged that its 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 16 leases for eight shellfish operations, including the 2 leases at DBOC. With the exception of DBOC, these operations are located on state-owned tidelands. In addition, approximately nine aquaculture operations in the state operate on

granted or private tidelands and submerged lands not owned by the State of California (CDFG [Ramey], pers. comm., 2011d). NPS developed this impact analysis using CDFG production data provided in April of 2012 (CDFG 2011e). In August of 2012, after NPS had completed this analysis, including IMPLAN modeling, CDFG notified NPS that in May of 2012 it changed its methodology for estimating state shellfish production. NPS acknowledges these changes; however, because these data were received after completion of the socioeconomic analysis, and are not anticipated to result in significant changes to NPS findings or conclusions, they have not been incorporated in this EIS.

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 commercial shellfish 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 compose a gallon. At DBOC, CDFG has consistently considered 100 Pacific 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 Pacific oysters per gallon factor (CDFG [Ramey], pers. comm., 2011d). In addition, the conversion factor also varies by type of oyster. Approximately 300 Kumamoto or Eastern oysters compose 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 assumed 100 or 140 oysters per gallon for all types of oysters. Shellfish production data reported by Ted Kuiper, which were used by the Pacific Coast Shellfish Growers Association to determine 2008 oyster production rates and values in California, assume an average of 180 oysters per gallon to estimate both value and total oysters produced (Kuiper 2009).

Assumptions used to calculate quantities of Pacific oysters, total oysters, and shellfish produced in California for this analysis as provided in chapter 3 include the following:

- One gallon of oyster meat weighs 8.5 pounds
- Twenty mussels weigh 1 pound
- Thirty clams weigh 1 pound

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 composed between 16 and 35 percent of the oysters and between 13 and 33 percent 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 data are 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.

To assess DBOC's overall contribution to the regional economy under each alternative, an input-output analysis was conducted using IMPLAN modeling. As described in chapter 3 of this Final EIS, input-output models, such IMPLAN, map the linkages of inter-industry purchases and economic output in a given region. Revenue estimates, payroll, and employment data for DBOC have been incorporated into the analysis to quantify the direct impacts of DBOC operations on the regional economy, including an

estimate of value added. However, DBOC has requested that all financial data related to the operation of DBOC be kept confidential. Therefore, although data provided by DBOC were used as direct inputs and have been factored into the total effects, to adhere to DBOC's confidentiality request, separate direct, indirect, and induced impact data generated by the IMPLAN model have been excluded from the EIS. Only the total results are summarized under each of the alternatives. Where available, operation-specific payroll data can be input into IMPLAN to further refine results. The NPS has requested that DBOC provide payroll data for these purposes; however, DBOC did not provide this information. Instead, payroll was estimated by IMPLAN and considers the overall expenses and number of employees for DBOC and industry averages. These direct effect expenditures were applied to the model in *Industry Sector 14 – Animal production, except cattle and poultry and eggs. (This IMPLAN industry sector includes oyster production, farm raising* [NAICS Code 112512] and was selected as the industry that most closely resembled DBOC activity. *Sector 17 – Fishing and Sector 61 – Seafood product preparation and packaging* were also considered and tested, but did not appear to provide as close a match in terms of reported financial and employment conditions).In addition to the direct spending activity that is required to produce a dollar amount of a given product or service, IMPLAN also tracks and considers "indirect" purchases and "induced" spending Input-output models yield "multipliers" that are used to calculate the total direct, indirect and induced effect on jobs, income and output resulting from each dollar of spending on goods and services in the area of analysis. The IMPLAN analysis provides an assessment of the total direct, indirect and induced effect on jobs, income and output.

Geographic Area Evaluated for Impacts (Area of Analysis)

For the purposes of this socioeconomic analysis, the following areas of analysis have been defined:

Local Area of Analysis: The local area of analysis is defined as Inverness CDP. Local impacts include those that would noticeable to residents of Inverness CDP and/or small businesses.

Regional Area of 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 Area of Analysis: For the purposes of evaluating DBOC shellfish production, the State of California is considered the area of analysis for consistency with available shellfish production data, which are described in chapter 3 and summarized in the methodology above.

Intensity Definitions

Negligible: The impact is not detectable or measurable.

Minor: Impacts would be detectable but would not affect the overall economy.

Moderate: Impacts would be readily apparent but would not considerably affect the overall economy.

Major: Impacts would be readily apparent and would substantially influence the overall economy.

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 in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

The termination of commercial shellfish operations in Drakes Estero would result in the loss of 31 full-time jobs and 1 part-time job, which includes all current DBOC staff (DBOC 2010j[lxxvi]). From a regional perspective, 26 full-time DBOC staff and 1 part-time DBOC staff live in Marin County (22 of these in Inverness) and 5 full-time DBOC staff live in Sonoma County. DBOC makes up approximately 0.02 percent of the employed labor force in Marin County, 3.7 percent of the employed labor force in Inverness CDP, and 0.002 percent of the employed labor force in Sonoma County (DBOC 2010j;[lxxvii] U.S. Census Bureau 2006-2010). Assuming consistency with current employment data for Marin County and Inverness CDP, the closure of DBOC would not increase unemployment in these locales to a level above the 2010 statewide average which is 12.4 percent (U.S. Department of Labor 2011). Unemployment rates in Marin County in 2010 were 8.3, well below statewide averages in for that year (U.S. Department of Labor 2010). Inverness CDP reported zero unemployment (U.S. Census Bureau 2006–2010). Although the percent increase in the unemployment in Inverness CDP would be greater than that experienced by Marin County as a whole, unemployment levels would be approximately 4 percent, well below statewide averages (U.S. Census Bureau 2006-2010).

In addition to the loss of jobs, alternative A would require the relocation of the 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 2010j,[lxxviii] 2010k[lxxix]). At the time of report preparation, information pertaining to the total number of residents living in DBOC-provided housing was not readily available. Housing costs in Marin County and Inverness CDP are extremely high. The average cost to purchase or rent a home in Marin County and Inverness CPD was over $800,000 or approximately $1,500 per month between 2006 and 2010 (U.S. Census Bureau 2006-2010). As such, individuals may not have the opportunity to relocate in the immediate area. Former staff who choose to relocate outside 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 compose less than 0.01 percent of the housing in Marin County and 0.5 percent of the homes in Inverness CDP (U.S. Census Bureau 2010). Additionally, DBOC staff make up only a small percentage of the population of both Marin County (0.01 percent) and Inverness CDP (2.1 percent) (U.S. Census Bureau 2010).

If existing authorizations for DBOC are allowed to expire, DBOC would no longer produce and sell/distribute shellfish in Drakes Estero, and DBOC would cease to operate. DBOC estimates that approximately 50,000 people visit the oyster company annually (DBOC 2010n[lxxx]). This amounts to approximately 2.5 percent of the total visitors to the Seashore (NPS 2011a). Specific data regarding the percentage of DBOC visitors who travel to the Seashore solely to visit the oyster company are not available. 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). However, DBOC's specific contribution to the regional, state, and/or local economy could not be determined at the time of report development. Data are not available regarding the number of visitors that come to the Seashore for the sole purpose of visiting DBOC (versus those who also visit other areas of the Seashore during their trip). Visitors to DBOC who also come to experience other areas of the Seashore would contribute to the regional, state, and local economy regardless of DBOC's presence, whereas, those who only travel to DBOC may or may not continue to come to the Seashore. It is assumed that the Seashore, as a whole, would continue to contribute to the regional economy, at current levels. In 2010, visitation and payroll at the Seashore accounted for a total of approximately $51 million in labor income and $80 million in value added. This represents 0.5 percent of the value added for all of Marin County. Value added to the county economy from DBOC is equivalent to 1 percent of the Seashore's contributions, or 0.006 percent of the total value added in the county.

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 35 percent of the California oyster market and between 13 and 33 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). At a county level, DBOC produced 68 percent of the oysters cultivated in Marin County in 2007/2008 and 64 percent of the shellfish. However, between 2009 and 2011 shellfish production in Tomales Bay increased and DBOC's share of the county market decreased to approximately 50 percent. In 2010 aquaculture in Marin County composed 7.6 percent of the gross value of agricultural production (MCDA 2011).

Between 2007 and 2009, an average of 1.2 million pounds (17.1 million individuals) of shucked Pacific oyster meat, 1.3 million pounds (21.2 million individuals) of total shucked oyster meat, and 1.65 million pounds (22.9 million individuals) of shellfish were produced annually in California (CDFG 2011a, CDFG [Ramey], pers. comm., 2011d). This alternative would reduce the quantity of shellfish produced in California, which could result in price fluctuations. However, as described in chapter 3, shellfish as a commodity are relatively inelastic (Russo et al 2008, Sorte 2010), meaning that demand for shellfish would not likely change due to price increases (or decreases).

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. In 2011, Manila clam production at DBOC declined 83 percent compared to 2010 production, while statewide clam production only declined 20 percent. Although Manila clams were the only clams harvested in California in 2009 and 2010 (CDFG 2011b), because DBOC produces a very small percentage of the state's Manila clams, it is unlikely that alternative A would noticeably affect Manila clam production statewide.

Under alternative A, the termination of DBOC shellfish operations would result in the loss of the associated direct, indirect, and induced economic activity. As indicated in chapter 3 of this Final EIS, this includes approximately 31 jobs, and $1.1 million in value added (see table 3-8). DBOC has requested all financial data related to the operation of DBOC be kept confidential. Therefore, although data provided by DBOC were used as direct inputs and have been factored into the total effects, separate direct, indirect,

and induced impact data generated by the IMPLAN model have been excluded from the EIS. Only the total results are provided in table 3-8 and summarized here.

As described above, alternative A would result in long-term minor, adverse impacts on local and regional socioeconomic resources because DBOC staff would lose jobs and some staff and their families would also lose housing. These impacts would be detectable at a local scale, but would not affect the overall local or regional economy. Alternative A could result in long-term, major, adverse impacts on California's shellfish market because the loss of DBOC production (estimated at 13 to 33 percent of the state's shellfish production) would cause a readily apparent 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 in 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 some 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.

In 2010, 3 of the approximately 10 commercial entities authorized to offer kayak tour in the Seashore conducted kayak tours in Drakes Estero. A total of 221 visitors to the Seashore participated in kayak tours of Drakes Estero in 2010 (NPS 2010g). However, if commercial shellfish operations in Drakes Estero are terminated and the project area is converted to congressionally designated wilderness area, the demand for kayak tours in 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 in Drakes Estero, which may help to offset the loss of visitors to DBOC. Increased interest in kayaking in Drakes Estero would support the kayak operators, which, in most cases, are local small businesses. The potential increase in commercial kayak tours in 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 (including commercial shellfish operations) 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 in the state. Such regulatory changes could alter shellfish production levels. The inclusion of more or less stringent regulations also could lead to reduced or increased 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 whether production would increase or decrease as a result of PEIR implementation. As such, the potential impact of the PEIR on socioeconomic conditions in 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 United States; 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 (including commercial shellfish operations) 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 and 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 local and 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 in California. These actions include the proposed California Aquaculture PEIR, the expansion of commercial shellfish operations in 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 whether 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 commercial shellfish operations in Humboldt Bay are expanded, it would allow that region to produce a larger percentage of California's shellfish. In 2011, the Headwaters Fund awarded a grant to the Humboldt Bay Harbor District to support planning and permitting that could double the areas available to shellfish production in Humboldt Bay. While this grant could facilitate increased production areas, it is unlikely that the available shellfish production areas in Humboldt Bay would double in the foreseeable future. However, if shellfish operations in Drakes Estero cease in 2012, the proposed increase in commercial shellfish operations in Humboldt Bay could help reduce the associated socioeconomic impacts on the statewide oyster and clam production. As such, the expansion of commercial shellfish operations in 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 includes "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 and 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 local and 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 socioeconomic perspective, these impacts would be minimal and would not affect the overall regional economy. Based on employment, payroll, and revenue, DBOC accounts for 0.006 percent of the total value added in Marin County. DBOC staff composes 0.01 percent of the Marin County population and 2.1 percent of the Inverness population (U.S. Census Bureau 2010). 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 CDP, and even with the added job loss, assuming these jobs are not replaced by expanded shellfish operations elsewhere, unemployment rates in Marin County and Inverness CDP would be well below statewide averages of 12.4 percent (U.S. Department of Labor 2011). 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 0.5 percent of the homes in Inverness CDP) (U.S. Census Bureau 2010). 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 $85 million in 2010) and by supporting jobs (resulted in $12 million in added value to the region in 2010) (NPS 2011d). The cumulative impact on the local and regional economy would be long term, minor, and adverse, and alternative A would contribute a noticeable adverse increment to the cumulative impact.

Alternative A could result in long-term major adverse impacts on California's shellfish market because DBOC produces 16 to 35 percent of the oysters harvested in California and 13 to 33 percent of the total shellfish grown in the state. The cessation of commercial shellfish operations in Drakes Estero would be readily apparent and could substantially influence the production of shellfish in California. The cumulative impact on the California shellfish market would be long term, minor, and 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 in Drakes Estero. Actions associated with this alternative that would have the potential to impact socioeconomic resources include:

- the provision of employment
- the provision of housing
- the cultivation of species including the following:
  - Pacific oysters and Manila clams in Area 1
  - purple-hinged rock scallops in Area 2
- the 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 with its existing trucks, or comparable replacements, in 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, composing, between 16 and 35 percent of the California oyster market and between 13 and 33 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). At a countywide, assuming Tomales Bay production remains similar to current levels, DBOC would continue to produce approximately half of the oysters and shellfish in Marin County.

As described under alternative A, DBOC estimates that approximately 50,000 people visit the oyster company annually (DBOC 2010n[lxxxi]). DBOC visitors also are likely to spend money at local restaurants, shops, and/or hotels/motels, contributing further to the regional economy. However, as described previously, DBOC's specific contribution to the regional, state, and/or local economy could not be determined at the time of report development because data is not available regarding the number of visitors that come to the Seashore for the sole purpose of visiting DBOC (versus those who also visit other areas of the Seashore during their trip). Visitors to DBOC who also come to experience other areas of the Seashore would contribute to the regional, state, and local economy regardless of DBOC's presence, whereas, those who only travel to DBOC may or may not continue to come to the Seashore.

Under this alternative, DBOC contributions to the Marin County economy would be similar to current conditions, as described in chapter 3 of this EIS. Specifically, DBOC would continue to support a total of approximately $2 million in annual output, $1.1 million in annual value added, and 35 jobs (MIG 2012). This is approximately 0.006 percent of the county's total value added.

TABLE 4-4. IMPACT SUMMARY – PRODUCTION LIMIT OF 600,000 POUNDS OF SHELLFISH PER YEAR

Impact Type	Employment (Jobs)	Labor Income	Total Value Added	Output
Total Effect	34.9	$546,025	$1,117,575	$2,026,982

Source: MIG 2012; *DBOC 2010j[lxxxii]

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 its leaseholder. Lessees pay an annual per acre rental fee and a privilege use tax ($0.04 per gallon for oysters, $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 DOI Office of Valuation Services, completed an appraisal process to determine the fair market value of the project area. The appraisal was conducted in accordance with federal appraisal standards and was used to establish the fair market value of the new permit. 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 local, regional, and statewide socioeconomic resources due to the continued operation of a commercial shellfish facility in 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 on 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 on socioeconomic resources. The commercial shellfish operation in 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 on 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 in 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 in

Drakes Estero, the proposed California Aquaculture PEIR, the expansion of commercial shellfish operations in 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 and 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 local and 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 local, regional, and statewide socioeconomic resources due to the continued operation of a commercial shellfish facility in 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 economy would not change substantially from current 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 local and regional economy and statewide shellfish production would be long term and 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 would have the potential to impact socioeconomic resources are the same as those described under alternative B, with the following exceptions:

- the cultivation of species including the following:
  - Pacific oysters in Area 1
  - purple-hinged rock scallops in Area 2
- the production of up to 500,000 pounds of shellfish per year

In 2007/2008, DBOC produced between 16 and 35 percent of the oysters harvested in California and between 13 and 33 percent of the shellfish grown in the state (CDFG 2011a, 2011c, 2011e; PCSGA 2009; Kuiper 2009). During these years, DBOC averaged 451,691 pounds (5.31 million individuals) 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. At a countywide level, assuming Tomales Bay production remains similar to current levels, DBOC would continue to produce approximately half of the oysters and shellfish in Marin County.

The production limit associated with this alternative is approximately 85 percent of DBOC production in 2010. As such, an IMPLAN model was run using a proportionate decrease in gross sales to identify the regional economic impacts that would be expected from operations at this level. As described in the

alternative A and B impact analyses, DBOC has requested that financial data be kept confidential. Therefore, separate direct, indirect, and induced impact data generated by the IMPLAN model have been excluded from this EIS. Instead, a summary of the total results is presented above and in table 4-5. The IMPLAN analysis indicated that at production levels of 500,000 pounds of shellfish per year, DBOC would contribute approximately $1.7 million in annual output and $0.9 million in annual value added, and 34 jobs to the regional economy (see table 4-5). Based on this information, under alternative C, value added from DBOC operations would make up 0.005 percent of the county total. 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 at DBOC under alternative C.

TABLE 4-5. IMPACT SUMMARY – PRODUCTION LIMIT OF 500,000 POUNDS OF SHELLFISH PER YEAR

Impact Type	Employment (Jobs)	Labor Income	Total Value Added	Output
Total Effect	34.3	$464,121	$949,938	$1,722,935

Source: MIG 2012; *DBOC 2010j[lxxxiii]

As described under alternative B, the NPS, through the Office of Valuation Services, completed 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 local, regional, and statewide socioeconomic resources due to the continued operation of a commercial shellfish facility in 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 on 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 on socioeconomic resources. Impacts to socioeconomic resources associated with the 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 in the project area and region. Actions that have the potential to combine with the impacts of alternative C during the 10-year period of the new SUP include ranching operations, kayaking in Drakes

Estero, the proposed California Aquaculture PEIR, the expansion of commercial shellfish operations in 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 and 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 local and 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 local, regional, and statewide socioeconomic resources due to the continued operation of a commercial shellfish facility in 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 economy 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 local and regional economy and statewide shellfish production would be long term and beneficial, and alternative C would contribute a noticeable beneficial increment to the cumulative impact.

IMPACTS OF ALTERNATIVE D

Impact Analysis

Actions associated with alternative D that would have the potential to impact socioeconomic resources are the same as those described under alternative B, with the following exceptions:

- an uncertain level of housing for DBOC staff
- the cultivation of shellfish species including the following:
  - Pacific oysters
  - Olympia oysters
  - Manila clams
  - purple-hinged rock scallops
- the 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, except diversification of products could occur as follows: in addition to Pacific oyster products, DBOC would produce and distribute Manila clams (currently produced at DBOC but only distributed on site), Olympia oysters (not currently produced at DBOC), and purple-hinged rock scallops (permitted but not currently produced at DBOC). Impacts on 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 not only to diversify the types of shellfish produced but also to produce up to 850,000 pounds of shellfish per year. When compared to the 2010 reported production of 585,960 pounds (6,885,609 individual oysters and 20,520 individual clams), this alternative would allow an increase of 45 percent. When compared to the production limits established for the other alternatives, alternative D would allow approximately 40 percent more shellfish than under alternative B (production limit set at 600,000 pounds per year) and 70 percent more than under alternative C (production limit set at 500,000 pounds per year). Between 1996 and 2010, shellfish production in California was generally steady, averaging approximately 1.6 million pounds (14.8 million individuals) 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 similar to current conditions. Similarly, at a countywide level, if Tomales Bay production remains similar to current levels, DBOC could account for a larger percentage of Marin County shellfish production under alternative D. However, shellfish production in Tomales Bay has been steadily increasing since 2007. Therefore, it is likely that even with production increases at DBOC, the operations at Tomales Bay and DBOC would continue to account for approximately half the county's annual shellfish production each.

The production limit associated with this alternative would be approximately 145 percent of DBOC production in 2010. As such, an IMPLAN model was run using a proportionate increase in gross sales to identify the regional economic impacts that would be expected from operations at this level. As described in the impact analysis for the other alternatives, DBOC has requested that financial data be kept confidential. Therefore, separate direct, indirect, and induced impact data generated by the IMPLAN model have been excluded from this EIS. Instead, a summary of the total results is presented above and in table 4-6. The analysis indicated that at production levels of 850,000 pounds of shellfish per year, DBOC would contribute approximately $2.9 million in annual output and $1.6 million in annual value added, and 39 jobs to the regional economy (see table 4-6). Under alternative D, value added from DBOC operations would make up 0.009 percent of the county total.

TABLE 4-6. IMPACT SUMMARY – PRODUCTION LIMIT OF 850,000 POUNDS OF SHELLFISH PER YEAR

Impact Type	Employment (Jobs)	Labor Income	Total Value Added	Output
Total Effect	39.2	$791,736	$1,620,483	$2,939,124

Source: MIG 2012

As described under alternative B, the NPS, through the Office of Valuation Services, completed 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[lxxxiv]), Option 2 of alternative D would include 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[lxxxv]).At the time of report preparation, information pertaining to the total number of residents living

in the mobile homes in 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[lxxxvi]). The conceptual analysis provided in this document applies only to on-site development. If DBOC proposes to build housing in the SUP, additional compliance would be required. The construction of DBOC housing would not be permitted outside the SUP.

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 (the 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[lxxxvii]). 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 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 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 local and regional socioeconomic resources due to the continued operation of a commercial shellfish facility in Drakes Estero for another 10 years. No jobs would be lost and both the Seashore and DBOC would continue to contribute to the regional economy at current levels. The increased production could support up to two new jobs at DBOC. This alternative would result in a long-term beneficial impact on 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 on socioeconomic resources. Impacts on socioeconomic resources associated with the 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 in 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 in Drakes Estero, the proposed California Aquaculture PEIR, the expansion of commercial shellfish operations in 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 and 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 local and 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 local and 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; however, due to expanded opportunities for product diversification, these contributions could be slightly increased.

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 the commercial 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 CDP) (U.S. Census Bureau 2005-2009). Therefore, even if all DBOC staff who currently reside in on-site housing move to another community and/or county, the impact on the local and 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 and 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 on 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 its contribution to the California shellfish market. The

cumulative impact on statewide shellfish production would be long term and 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

The area of analysis for NPS operations is the boundary of the Seashore. 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". 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. FTE estimates provided in this section reflect anticipated levels of staffing for specific activities associated with each alternative, as well as differing levels of planning, oversight, and enforcement. This section includes an analysis of both direct and indirect impacts, and considers them over the long-term and short-term.

Intensity Definitions

Negligible: The impact is not detectable or measurable.

Minor: Impacts would be slightly detectable but would not hinder the overall ability of the NPS to provide services, manage resources, or operate the Seashore.

Moderate: Impacts would be readily apparent and could appreciably obstruct the ability of the NPS to provide services, manage resources, and/or operate the Seashore.

Major: Impacts would be readily apparent and would potentially have a permanent influence on the ability of the NPS to provide services, manage resources, and/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 infrastructure related to commercial shellfish operations in Drakes Estero, cultivated shellfish, and any improvements made to the area since 1972).

In addition, under alternative A, baseline surveys and resource monitoring would occur to assist with identifying the extent and distribution of target resources including benthic and infaunal communities (tunicates, Manila clams, Olympia oyster, etc.) and eelgrass. These surveys and monitoring results would provide site-specific data and lead to a better understanding of the natural ecological processes in Drakes Estero, thus improving the long-term management of Drakes Estero. It is estimated that two new six-month seasonal positions would be required to assess and monitor invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness.

NPS oversight of the closeout of DBOC operations, the removal of personal property and designated structures, and the conversion to wilderness would include personnel to monitor closeout procedures and initiate ongoing wilderness monitoring and management efforts. Existing staff efforts associated with the Seashore visitor facilities, including the Seashore 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 the continued maintenance of these facilities would be similar to current efforts. However, administrative commitments (cost and time) related to DBOC management, including negotiation, oversight, and compliance for the SUP, would be reduced under this alternative. 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 the 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 Drakes Estero during boat closure periods and enforcing the closures. 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 the restoration of the onshore developed area following SUP expiration,

monitoring/managing invasive species, actions under the existing fire management plan, moving the vault toilet out of the flood hazard area, 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 aside from 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 in 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.

Planning and management activities would result in short-term increases in management and administration resources to coordinate planning efforts and develop planning documents. The 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, and moving the vault toilet out of the flood hazard area would have similar impacts. 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 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 and 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. Although existing NPS staff would be required for monitoring and enforcement during the Drakes Estero boat closure period, the installation of an access gate would increase effectiveness of the closure and further protect harbor seal pupping habitat. Two new part-time (seasonal) positions also would be required to assess and monitor invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness. These efforts would not hinder the overall ability of NPS to provide services, manage resources, or operate the Seashore. The cumulative impact would be long term, minor, and adverse, and alternative A would contribute a 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would have the potential to impact NPS operations include:

- NPS administration of DBOC operations and facilities
- The maintenance of NPS facilities in the project area

DBOC would be required to pay fair market value for the use of federal property, which includes onshore and offshore areas in 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. As a condition of issuance of the SUP, DBOC would surrender its 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 in the permit area. To effectively manage the SUP, the NPS would establish a staff position to coordinate Seashore oversight, management, and enforcement of the existing operations. This position also would be responsible for assisting with documentation of monitoring and mitigation efforts prescribed for this alternative.

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. As described in chapter 1, pursuant to Division 12 of the Fish and Game Code, CDFG is responsible for regulating the stocking of aquatic organisms, brood stock acquisition, disease control, and the importation of aquatic organisms into the state. CDFG also collects payments from aquaculture operators, including an annual lease fee based on the number of acres included in the lease and privilege use taxes, which are based on the gallons of shellfish produced as reported by monthly statements. CDPH would maintain all responsibilities associated with shellfish water quality and production monitoring and management.

As under current conditions, NPS would continue to enforce the 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 in Drakes Estero during this four-month period, subject to the SUP. As part of the increased coordination, the NPS would increase the enforcement of the closure to reduce the potential disturbance of harbor seals by nonmotorized recreational boaters. DBOC would only operate in 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 Seashore visitor facilities, including the Seashore 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, the 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. In addition, as described under alternative A, this alternative would include continued monitoring of invasive species in the Seashore. It is estimated that two six-month seasonal positions would be required to assess and monitor invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness. The addition of these positions would result in long-term minor adverse impacts on NPS operations because the 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 on NPS operations in Drakes Estero. Impacts on NPS operations associated with the 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 the existing fire management plan, moving the vault toilet out of the flood hazard area, planning and management activities, and coastal watershed restoration projects (Geomorphic 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, and 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 the discontinuation of DBOC operations in 2022 and the restoration of the onshore developed area, 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 in 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 adult form in soft-bottom estuaries such as Drakes Estero). The continued commercial shellfish operations 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 assessment and monitoring, as compared to alternative A. This risk would result in adverse impacts extending beyond 2022 despite the 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 the establishment of one FTE position to manage and oversee all aspects of the SUP. In addition, two half-time (seasonal) positions would conduct monitoring and management of invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness. These impacts would be slightly detectable but would not hinder the overall ability of NPS to provide services, manage resources, or operate the Seashore. The cumulative impact would be long term, minor, and 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would have the potential to impact NPS operations are the same as those 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) would also not be 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 one FTE position to coordinate Seashore oversight and enforcement for the existing operations. Existing staff efforts associated with the Seashore visitor facilities, including the Seashore 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 alternatives, and as described under alternative A, two six-month seasonal positions would be required to assess and monitor invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness. The addition of these positions would result in long-term minor adverse impacts on NPS operations because the impact would be slightly detectable but would not hinder 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 on NPS operations in Drakes Estero. Impacts on NPS operations associated with the 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 actions under the existing fire management plan, moving the vault toilet out of the flood hazard area, 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, and 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 the discontinuation of DBOC operations in 2022 and the restoration of the onshore developed area, 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 in 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 adult form soft-bottom estuaries such as Drakes Estero). The commercial shellfish operation 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 the 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 the establishment of one FTE position to manage and oversee all aspects of the SUP and two part-time (seasonal) staff who would assess, monitor, and manage invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness. These impacts would be slightly detectable but would not hinder the overall ability of NPS to provide services, manage resources, or operate the Seashore. The cumulative impact would be long term, minor, and 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 in and adjacent to Drakes Estero. Actions associated with this alternative that would have the potential to impact NPS operations are the same as those described under

alternative B, with a few exceptions. Differences from alternative B that would have the potential to impact NPS operations include

- an 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 their 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 in 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. The issuance of a permit under alternative D would require one FTE staff position to provide oversight and coordinate enforcement of the SUP, two half-time FTEs to assess and monitor invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness, and an additional 2-year planning position to coordinate NEPA compliance for the proposed onshore development as well as ensure any site specific permitting requirements are met.

Existing staff efforts associated with the Seashore visitor facilities, including the Seashore 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 the 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 on NPS operations in Drakes Estero. Impacts on NPS operations associated with the 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 actions under the existing fire management plan, moving the vault toilet out of the flood hazard area, 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, and 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 the discontinuation of DBOC operations in 2022 and the restoration of the onshore developed areas, 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 in 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 adult form in soft-bottom estuaries such as Drakes Estero). The commercial shellfish operations 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 the 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 the establishment of one dedicated FTE position to coordinate Seashore oversight and enforcement of all aspects of the SUP. The NPS would oversee and enforce all aspects of the operation in the permit area. Construction on new onshore facilities also would require one 2-year planning position to oversee additional planning and compliance associated with the proposed onshore development evaluated at the conceptual level in alternative D. The staff increase under alternative D also would include two half-time FTEs who would conduct assessment, monitoring, and management of invasive species and other resources of concern in the Drakes Estero portion of the Phillip Burton Wilderness. These impacts would be slightly detectable but would not hinder the overall ability of NPS to provide services, manage resources, or operate the Seashore. The cumulative impact on NPS operations would be long term, minor, and 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 Seashore'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 U.S. 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 Seashore 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 in Drakes Estero. Further, the continued use of offshore infrastructure would maintain the potential for *Didemnum* expansion, and associated activities (such as infrastructure maintenance, vessel traffic, and harvesting) would pose a risk for further dispersal of this nonnative invasive tunicate. However, 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 Seashore 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 (except under alternative C – as cultivation of Manila clam would be prohibited), becoming established in 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 in 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, fish, and birds) 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 and Manila clams – except under alternative C, as clams would be prohibited) in 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 in 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. Continued use of motorboats and other noise-producing equipment, as well as maintenance of shellfish growing structures in 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.

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 in 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. DBOC 2011d, 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. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, 2012, regarding DBOC responses to the National Park Service's April 2012 questions.

> "The description of boat operations in the NAS report and the conversations between DBOC staff and VHB/NPS staff generally describes the current boat use in Drakes Estero. … DBOC began with three boats in operation at one time, then reduced to two boats, and currently uses three boats again. Albeit unusual, all boats can be in the Estero all day. Sometimes, boat use is required 7 days a week. On other days, no boats enter the estero at all. As a working farm, DBOC must work around tides, weather, day length, planting season, high demand occasions, etc. The oyster farm has always operated with these variable demands and will continue to in the future."

iii. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, 2012, regarding DBOC responses to the National Park Service's April 2012 questions.

> "The description of boat operations in the NAS report and the conversations between DBOC staff and VHB/NPS staff generally describes the current boat use in Drakes Estero. … DBOC began with three boats in operation at one time, then reduced to two boats, and currently uses three boats again. Albeit unusual, all boats can be in the Estero all day. Sometimes, boat use is required 7 days a week. On other days, no boats enter the estero at all. As a working farm, DBOC must work around tides, weather, day length, planting season, high demand occasions, etc. The oyster farm has always operated with these variable demands and will continue to in the future."

iv. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "DBOC occasionally uses cinder blocks as anchors as well as the PVC pipe anchors. DBOC also uses larger concrete anchors."

v. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "The seawater intake will be comprised of 2 – 4" black, high density polyethylene, fusion welded pipes, side by side. Two pipes will be used so that bio-fouling inside the pipes can be controlled. Only one pipe will be used at a time. The other pipe will be plugged while not in use. During the time of non-use, the fouling organisms in the idle pipeline will die, thereby allowing for full flow while pipe is in use. The intake will be screened using ¼" mesh screen with 16 square feet of surface area. The flow rate through the intake screen is .005 feet per second (attachment 3.m.1). The pipes will be installed side by side on the Estero bottom. The pipes will be anchored using two concrete anchors (attachment 3.f.1) every 100 feet. The anchors will be buried by hand on each side of the pipelines. The pipes will be fastened securely to the anchors with 3/8" stainless steel cable. The pipes will remain full of water at all times. The intake screen will be located approximately 2' above the bottom of the Estero and will be marked with a buoy secured with a concrete anchor. The intake screen will be maintained approximately two times per year. DBOC previously provided a map showing the proposed location of the seawater intake lines to CCC and NPS."

vi. Wechsler 2004, 13: “Aquatic macrophytes, primarily eelgrass (*Zostera marina*) beds, were the predominant form of subtidal and intertidal biological material in Drakes Estero.”

vii. 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.”

viii. Wechsler 2004, 29: “eelgrass growth is restricted directly beneath the oyster racks due to light attenuation.”

ix. DBOC 2012c, Letter from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on May 7, regarding Coastal Development Permit Application No: 2-06-003.

> “Purple hinged rock scallops have traditionally been raised in Drakes Estero using floating racks, floating trays and lantern nets. DBOC plans to continue to culture these native scallops using similar techniques.”

xi. 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.”

xii. 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.”

xiii. 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…”

xiv. DBOC 2012c, Letter from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on May 7, regarding Coastal Development Permit Application No: 2-06-003.

> “Purple hinged rock scallops have traditionally been raised in Drakes Estero using floating racks, floating trays and lantern nets. DBOC plans to continue to culture these native scallops using similar techniques.”

xv. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service’s April 2012 questions.

> “DBOC occasionally uses cinder blocks as anchors as well as the PVC pipe anchors. DBOC also uses larger concrete anchors.”

xvii. 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.”

xviii. Wechsler 2004, 34: “Appendix A. List of all species captured during the Drakes Estero Ichthyofauna – Oyster Mariculture Study, Drakes Estero, Point Reyes National Seashore.”

xix. Wechsler 2004, 34: “Appendix A. List of all species captured during the Drakes Estero Ichthyofauna – Oyster Mariculture Study, Drakes Estero, Point Reyes National Seashore.”

xx. Wechsler 2004, 18: “Five species, topsmelt (*Atherinopsis affinis*), three-spined stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), bay pipefish (*Sygnathus leptorhynchus*), and kelp surfperch (*Brachyistius frenatus*) dominated the fish assemblage and accounted for eighty-nine percent of the total catch (Table 3).”

xxi. 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.”

xxii. 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.”

xxiv. Wechsler 2004, 19: “Table 3. Relative abundance of the fish species captured during the Drakes Estero Ichthyofauna – Oyster Mariculture study, Point Reyes National Seashore, December 2002 – January 2004.”

xxv. Wechsler 2004, 20-21: “Calculated ANOVA values indicated that there were no significant difference in the abundance of fish over time (F=0.55, p=0.01) or among sites (F=0.23, p=0.01) between Schooner Adjacent, Schooner Away, and Estero de Limantour. There were also no significant differences in the number of species captures (F=1.07, p=0.01) or number of species among sites (F=0.16, p=0.01) during this study (Table 4).”

xxvi. Wechsler 2004, 21: “Four of the five similarity tests (Renkonen Percent Similarity, Euclidian Distance, Bray-Curtis Index, Morista Index) indicated that the fish communities near Schooner Adjacent and in Estero de Limantour were the most compositionally divergent (Table 5).”

xxvii. Wechsler 2004, 27: “Four of the five similarity indices used to assess the similarity of the fish assemblages showed the greatest compositional divergence was between Estero de Limantour and Schooner Adjacent. This suggested that the use of the artificial habitat derived from mariculture facilities attracted opportunistic fish species to the racks if they provide resources not otherwise available, or supplemented preexisting conditions.”

xxviii. Wechsler 2004, 24: “Juvenile fish were captured in the estero throughout this study, which indicated that the estero fulfills a substantial nursery function (Table 7).”

xxix. Wechsler 2004, 22-23: “Of the predominant benthic feeding species, speckled sanddab (*C. stigmaeus*), wooly sculpin (*C. analis*), and leopard sharks (*T. semifasciata*) were captured more frequently in Schooner Adjacent.”

xxx. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service’s April 2012 questions.

> “Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following.”

xxxi. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service’s April 2012 questions.

> “Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following.”

xxxii. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service’s April 2012 questions.

> “Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following.”

xxxiii. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service’s April 2012 questions.

> “Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following.”

xxxiv. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service’s April 2012 questions.

> “Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following.”

xxxv. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "The description of boat operations in the NAS report and the conversations between DBOC staff and VHB/NPS staff generally describes the current boat use in Drakes Estero. … DBOC began with three boats in operation at one time, then reduced to two boats, and currently uses three boats again. Albeit unusual, all boats can be in the Estero all day. Sometimes, boat use is required 7 days a week. On other days, no boats enter the estero at all. As a working farm, DBOC must work around tides, weather, day length, planting season, high demand occasions, etc. The oyster farm has always operated with these variable demands and will continue to in the future."

xxxvi. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following."

xxxvii. Wechsler 2004, 30. "The calm nutrient-rich waters of Drakes Estero provide ample nursery and rearing habitat for marine fishes. This protected environment likely provides numerous feed, spawning, and predator avoidance opportunities not otherwise available in Drakes Bay or the Pacific Ocean."

xxxviii. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

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> "Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following."

xli. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following."

xlii . Anima 1990. 41. "The estero is defined as a coastal lagoon because of the minimal influx and dilution of sea water by fresh water."

xliii. Anima 1990, 42. "The tides in the study area are semidiurnal with a tidal range of between -2.0 to 2.2 meters in Drakes Estero."

xliv . Wechsler 2004, 12. "The estero is mesotidal with semidiurnal tides that range between approximately 0.6-meters below and 2.13-meters above mean sea level."

xlv. Wechsler 2004. 12-13. "The high width to depth ratio combined with a large exchange volume results in a well-mixed water body with no stratification."

xlvi. Wechsler 2004, Appendices B and C.

xlvii. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "The time the oysters are kept on the beaches varies – up to about 9 months, turned about every month or two."

xlviii. Wechsler 2004, 12-13. "The high width to depth ratio combined with a large exchange volume results in a well-mixed water body with no stratification."

xlix. Wechsler 2004. Appendices B and C.

l. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, 2012,regarding DBOC responses to the National Park Service's April 2012 questions.

> "The time the oysters are kept on the beaches varies – up to about 9 months, turned about every month or two. … Only about 2 months of beach hardening is necessary, but because of current limited rack space, oysters are removed much sooner to allow for new seed."

li. Wechsler 2004. Appendices B and C.

lii. Wechsler 2004. Appendices B and C.

liii. DBOC 2012b. Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "DBOC typically uses the areas in and around the racks for the floating bag culture. Currently, racks that are in poor condition and cannot support strings are used for floating bags. In these cases, the existing posts are used as anchors. Sometimes, the bags are floating between racks, using the racks as anchors. Other floating systems near the racks are secured by concrete anchors."

liv. DBOC 2012b. Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "When DBOC is allowed to resume the rack repairs, and more racks are again available, the oysters can remain on the racks for a longer period of time and on the beaches for a shorter time."

lv. Anima 1990. Pages 66 – 71.

lvi. Anima 1990. "The results can be compared to the National Academy of Sciences National Academy of Engineering (1973) recommended safe level of 1.0 mg/kg (sum) DDT (the sum of DDD, DDE, and DDT) wet weight for the protection of fish-eating wildlife."

lvii. DBOC 2012b. Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "DBOC typically uses the areas in and around the racks for the floating bag culture. Currently, racks that are in poor condition and cannot support strings are used for floating bags. In these cases, the existing posts are used as anchors. Sometimes, the bags are floating between racks, using the racks as anchors. Other floating systems near the racks are secured by concrete anchors."

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lx. NPS 2004d, 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."

lxi. CDFG 2004a, 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."

lxii. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following."

lxiii. DBOC 2010n, 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."

lxiv. DBOC 2010n, 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."

lxv. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit.

> ""DBOC is the only farm of any kind in PRNS permitted to provide visitor and interpretive services to the visiting public. Without DBOC, Seashore visitors would completely lose any opportunity for services and interpretation in the Pastoral Zone or PRNS."

lxvi. Cummings 2011, Letter from Ginny Lunny Cummings to Point Reyes National Seashore on December 7, 2011 regarding public comments on the National Park Service Draft Environmental Impact Statement Special Use Permit.

> "Many [visitors] tell us they come to PRNS only to visit the oyster farm, not to hike, kayak, bird watch, visit beaches or the lighthouse or to whale watch. Rather, these visitors enjoy picnicking with family and friends at the oyster farm. Picnicking is an historical and important part of our farm visiting public's visitor experience and recreation."

lxvii. DBOC 2010r, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, 2010, regarding interpretive services.

> "Our comprehensive tours of Drakes Bay Oyster Company include the historical, cultural and ecological aspects of oyster farming in Drakes Estero. We also regularly include the broader subjects of sustainable agriculture, organic production and the history of other generational Seashore food producers in PRNS, including the dairy and beef ranches."

lxviii. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on the National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "DBOC plays an essential role in educating the public on the history of oyster farming in PRNS, oysters' values as a beneficial source of protein, coastal ecosystems, and the nature and efficacy of organic sustainable farming."

lxix. Tomales Bay Oyster Company 2011, Letter from the Tomales Bay Oyster Company, LCC to Point Reyes National Seashore on December 7 regarding Tomales Bay Oyster Company, LCC comments on the National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "We have expanded our operations in Tomales Bay to capacity. Although we maximize our production levels, the demand for oysters is too high for Tomales Bay growers to meet. We, therefore, cannot possibly make up any of the supply lost if Drakes Bay Oyster Company (DBOC) is closed. Because we cannot produce enough in Tomales Bay, our businesses currently purchase oysters from growers out of our region. Closing DBOC will cause a loss of local shellfish production that cannot be replaced. This is not speculation. The EIS failed to consult with local experts and have made incorrect assertions. The EIS must properly analyze the loss of the local shellfish production and the impacts to the local economy.
>
> The Tomales Bay Oyster Company retail and picnic areas are at capacity and cannot expand. We already struggle with parking issues and traffic congestion. There is a clear lack of overflow picnic areas public or private to accommodate visitors to the oyster farm. DBOC customer base of 50,000-plus people will also lose the opportunity to be educated about the sustainable food production that farmed shellfish represents."

lxx. Hog Island Oyster Company 2011, Letter from the Hog Island Oyster Company to Point Reyes National Seashore on December 9 regarding Hog Island Oyster Company comments on the National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "The production in Drake's Estero is equal to or greater than all the production in Tomales Bay; the growers in Tomales Bay are all operating at or near capacity on our existing leases, and new lease areas very limited."
>
> We have hoped to expand our operation in Tomales Bay, but due to the onerous and expensive permit process, have found that nearly impossible. Shellfish farmers are highly regulated. Establishing a new shellfish farm involves obtaining permits and approvals at the local, state and

> federal levels. Estimates for permits and environmental consulting for a new lease in Tomales Bay (which are capped at 5 acres) are well in excess of $100,000, and could easily take over 3 years to complete. The current difficulty of obtaining permits will only increase up and down the entire West Coast, as the erroneous conclusions reached in the DEIS have the potential to migrate into the decision making processes of other agencies.
>
> Shellfish companies of all sizes provide local jobs that are particularly important to rural communities. Our company currently employs over 25 people at our Tomales Bay facility and another 80 in the San Francisco Bay area. As much as we would like to we would not be able to absorb any of the laid off workers from DBOC. Those jobs would be lost to the West Marin community.
>
> Our company, Tomales Bay Oyster Company and Drakes Bay Oyster Company all provide an important visitor serving function. People have the opportunity to visit a shellfish farm, learn about sustainable aquaculture, and purchase products that are healthy and produced in an environmentally sustainable manor (don't ask me – try Seafood Watch, Fish Wise or Food and Water Watch Smart Seafood). Our sites on Tomales Bay are near capacity. We cannot accommodate the 50,000+ annual visitors that would come to us if DBOC was shut down."

lxxi. DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, regarding DBOC responses to the National Park Service's April 2012 questions.

> "Moving forward, DBOC plans to make repairs to approximately 50 racks during 2013, 25 racks during 2014 and regular maintenance to all racks each year following."

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lxxiii. DBOC 2011g, Letter (with attachments) from Drakes Bay Oyster Company to Point Reyes National Seashore 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).

lxxiv. DBOC 2011g, Letter (with attachments) from Drakes Bay Oyster Company to Point Reyes National Seashore 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).

lxxv. DBOC 2011g, Letter (with attachments) from Drakes Bay Oyster Company to Point Reyes National Seashore on March 5, regarding alternate building design.

> "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."

lxxvi. DBOC 2010j, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, regarding employee list. Provided a list of current staff (as of the date of the letter).

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lxxviii. DBOC 2010j, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, regarding employee list. DBOC provided a list of current staff, including the home address of each (as of the date of the letter).

lxxix. DBOC 2010k, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, regarding housing.

> "DBOC provides five homes with a total of 14 bedrooms for its employees; and in some cases, their families."

lxxx. DBOC 2010n, 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.

lxxxi. DBOC 2010n, 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.

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> "The concept drawings do not show any worker housing except a manager's residence. Worker housing may be incorporated into the design in the future."

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