Compatibility Determination

Title

Compatibility Determination for Aquaculture and Commercial Shellfishing and at Congressman Lester Wolff Oyster Bay National Wildlife Refuge

Refuge Use Category

Fishing and Aquaculture

Refuge Use Type(s)

Shellfishing (commercial) and Aquaculture

Refuge

Congressman Lester Wolff Oyster Bay National Wildlife Refuge

Refuge Purpose(s) and Establishing and Acquisition Authority

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…" (Migratory Bird Conservation Act, as amended [16 U.S.C. 715-715d, 715e, 715f-715r]).

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (Pub. L. 105-57; 111 Stat. 1252).

Description of Use

Is this an existing use?

Yes, aquaculture and commercial shellfishing have been conducted in the Oyster Bay and Cold Spring Harbor estuary complex (estuary) prior to and since the establishment of the Congressman Lester Wolff Oyster Bay National Wildlife Refuge (refuge) in 1968. These activities continued to occur after the establishment of the refuge, as the Town of Oyster Bay (Town) reserved the rights to shellfish-related activities at the time of donation (see "Why is this use being reevaluated" for details). These ongoing activities include seeding efforts by commercial operators/lessees, the Town's shellfish hatchery program, the Long Island Shellfish Restoration Project, and commercial harvesting by corporations and commercial harvesters.

Historically, shellfish aquaculture has exclusively involved two bivalve species regulated by New York State (State) that occur in the estuary: hard clams, also known as northern quahogs (*Mercenaria mercenaria*), and Eastern oysters (*Crassostrea virginica*). The Town plans to continue aquaculture for these two species and may additionally develop plans and implement restoration aquaculture for soft shell clams (*Mya arenaria*), but is not currently planning aquacultural activities for any other shellfish species.

Commercial shellfishing is linked to the aquaculture program and therefore has also focused primarily on harvesting hard clams and oysters. Under State regulation and Town Code, other shellfish species that may be harvested include soft shell clams or steamers, blue mussels (*Mytilus edulis*), bank or ribbed mussels (*Geukensia demissa*), and bay scallops (*Argopecten irradians*). Of these other species, only harvests of soft shell clams have been reported in recent years, and in much lower quantities than historic hard clam and oyster harvests. The U.S. Fish and Wildlife Service (FWS) is not aware of soft shell clam harvesting occurring within the refuge but cannot exclude that possibility. This CD primarily focuses on clam and oyster aquaculture and shellfishing, while addressing the other shellfish species for evaluation and determination purposes as well.

The FWS is reevaluating its 1994 compatibility determination (CD) for *Aquaculture/Shellfish Harvest* and replacing it with two CDs for the refuge. This CD evaluates aquaculture and commercial shellfishing. A separate CD evaluates recreational shellfishing.

The use is being reevaluated per the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee; Refuge Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act) (Public Law 105-57) (which mandates that FWS reevaluate each existing use at least every ten years), FWS regulations and policy, and as a result of a legal settlement in *North Oyster Bay Baymen's Ass'n v. U.S. Fish and Wildlife Service, et al.*, C.A. No. CV-23-3155 (E.D.N.Y.) *See* 16 U.S.C. § 668dd(d)(3)(B)(vii); 50 C.F.R. § 26.41(a)(15).

The 1994 CD concluded shellfishing was compatible because it was considered outside the FWS' jurisdiction based on deed language from the Town. The recent legal settlement involved a lawsuit by the North Oyster Bay Baymen's Association and Center for Food Safety on April 26, 2023, which alleged that FWS violated the Refuge Administration Act by failing to reevaluate the compatibility of shellfish harvesting in the refuge and failing to require special use permits for commercial activities in the refuge. The lawsuit was settled on April 29, 2024, and required that FWS "issue a final CD evaluating whether use of refuge lands and waters for shellfish harvesting, including via hydraulic and mechanical dredging, is compatible with the refuge's purposes, as defined by federal law and in the Deed."

The FWS is reevaluating shellfishing by distinguishing it as two separate uses—recreational and commercial (including aquaculture)—due to differences in harvest methods, tools, environmental impacts, locations, and seasonal timing. Recreational shellfishing is considered a wildlife-dependent, priority public use of the refuge, whereas commercial shellfishing is not. As a result, each use is subject to a different evaluation standard (50 CFR 25 and 29).

What is the use?

This CD evaluates aquaculture and commercial harvesting of shellfish on the refuge as these uses are reserved rights of the Town as identified in the deed at the time of donation.

Aquaculture activities, as described in the “How is the use conducted” section, are intended to improve the ecological health of the estuary and will contribute to the ongoing support of the Town’s recreational and commercial shellfishing opportunities. The activities include acquiring clam and oyster seed, distributing seed in the refuge and more broadly in the estuary, and placing approved substrate in these areas to improve habitat conditions and support shellfish settlement. The Town’s aquaculture program provides capacity and ability to accomplish vital restoration needs on the refuge that FWS is unable to achieve.

This CD does not evaluate other aquaculture uses including commercial leases, licenses, or permits for confined shellfish rearing (floating or on-bottom aquaculture).

Commercial shellfishing refers to the commercial harvesting of shellfish within the estuary that could be sold for income or revenue or traded for goods or services.

Per FWS policy, commercial shellfishing with aquaculture is considered a “refuge management economic activity” (603 FW 2.6(N)), which is “a refuge management activity on a national wildlife refuge that results in generation of a commodity which is or can be sold for income or revenue or traded for goods or services.” Such use will only be authorized if FWS determines that “the use contributes to the achievement of the national wildlife refuge’s purposes or the National Wildlife Refuge System mission” (50 C.F.R. § 29.1).

FWS is evaluating aquaculture and commercial shellfishing in a single CD because aquaculture is foundational to commercial shellfishing; the viability and impacts of commercial shellfishing depend on the success of the aquaculture program. Moreover, the socioeconomic benefits of commercial shellfishing provide a strong incentive for an effective aquaculture program and successful ecological restoration of the estuary.

Is the use a priority public use?

No

Where would the use be conducted?

In the following paragraphs, we provide a description of areas where aquaculture and commercial shellfishing are allowed or restricted by the New York State Department of Environmental Conservation (NYDEC) and the Town.

The NYDEC classifies shellfish harvest areas based on water quality sampling to determine whether shellfish harvest can occur safely for human consumption. Certified waters are those deemed to be safe to harvest shellfish for human consumption, whereas shellfish harvesting is prohibited from uncertified waters. Within the refuge, NYDEC has classified areas as uncertified waters, seasonally closed waters, and certified waters. These areas are updated annually and can be viewed on NYDEC's website (https://dec.ny.gov/things-to-do/shellfishing/closures).

The estuary spans approximately 6,000 acres. The refuge boundary encompasses more than 3,000 acres of bay bottom and surface waters up to the mean high tide line within the estuary. The Town and NYDEC regulate shellfishing activities and determine where shellfishing may occur within the estuary. Commercial shellfishing areas on the refuge are identified as those areas within certified waters that are not otherwise restricted.

The Town has designated management areas that are defined in Town Code (section 196-4) as "an area designated or set aside by the Town Board for the conservation, preservation, protection, seeding, rehabilitation and/or growth of shellfish, or to promote the health, safety, and welfare of the residents…" The Town established 557 acres of management areas within the estuary, designated as either a Shellfish Sanctuary Area (SSA, 185 acres) or Marine Management Area (MMA, 372 acres). An estimated 151 acres of SSAs and 342 acres of MMAs overlay with the refuge. These areas are summarized in Table 1. Marine Management Areas would allow for eventual harvest when stocks are deemed sufficient as prescribed in the management and monitoring program developed by the Town in collaboration with FWS, provided they are located within a certified water body. The Town prohibits harvest in SSAs. Most of the refuge does not overlay Town MMAs or SSAs and thus would be open to commercial shellfish harvest if continued to be designated by NYDEC as certified waters (approximately 2,480 acres).

Table 1. Summary of the Town of Oyster Bay's Marine Management Areas and Shellfish Sanctuary Areas within the Refuge as of January 2026

Area	Description	Harvest Status	Approximate Total Acres within Refuge
Marine Management Areas	Areas proposed to be set aside for resource management activities including seeding clams and oysters, planting of adult shellfish and other restoration actions.	Harvest Prohibited, Potential to consider future harvesting	342

Shellfish Sanctuary Areas	Proposed sanctuary areas where shellfish can thrive and spawn without harvesting or other disturbance	Harvest Prohibited	151
Waters not designated as MMA or SSA	Remaining acres of waters in the refuge that do not fall in the Town-designated management or sanctuary areas	2,480 acres open to commercial harvest 375 acres closed to harvest due to current NYDEC designation as uncertified waters	2,855

Per Town Code (196-17), commercial shellfishing takes place in waters deeper than 3 feet at mean low tide, with an exception for harvest of soft shell clams. Town Code (§196-15) specifies "commercial shellfishing of soft shell clams is permitted in less than three feet of water in areas specifically designated by the Commissioner of the Department of Environmental Resources of the Town of Oyster Bay, from time to time." The FWS estimates that based on current information, approximately 2,250 acres of the refuge's more than 3,000 acres could be available for commercial shellfish harvesting in waters deeper than 3 feet at mean low tide, plus an additional 230 acres below three feet of water could be available for soft shell clam harvest if designated by the Town (for a total of 2,480 acres). The remaining acres are designated by the Town or State as uncertified waters, MMA, or SSA where shellfishing does not currently occur. The MMAs and SSAs are designated with buoys, with signage to convey the areas are closed to harvest. An additional 40 acres are subject to seasonal closures as determined by NYDEC. The areas open to harvest may change as the Town adjusts its management areas or opens MMAs for harvest, or NYDEC adjusts closure areas. Additionally, FWS will coordinate with the Town to determine if additional spatial and temporal restrictions are needed to protect shellfish and other species and to maintain shellfish populations at a level needed to ensure compatibility with refuge purposes or the Refuge System mission.

On the refuge, aquaculture activities addressed in this CD may occur across the entirety of the underwater lands but, at least initially, are expected to focus within the MMAs and SSAs.

When would the use be conducted?

Seeding and transplantation of shellfish would typically occur when water temperatures are between 50 and 80 degrees Fahrenheit (this temperature range on average begins in April and extends into November). This temperature range helps to ensure the oysters and clams are active enough to dig into the sediments or attach to substrate, while avoiding the stresses that come with temperatures outside of that range (Gobler et al. 2022). Additionally, spawning activity typically falls within this temperature range for these species, so this timing allows for both optimal establishment and initial reproduction (Cunningham et al. 2025). To protect winter flounder (*Pseudopleuronectes americanus*) eggs and larvae, the placement of shells or other bulk substrate will be avoided within the refuge from January 15 to May 31, as determined through coordination with the National Oceanic and Atmospheric Administration (NOAA) Fisheries and the Town, which has confirmed that substrate placement currently takes place outside this time period.

As of January 2026, the Town allows commercial harvest of shellfish year-round between sunrise and sunset with the exception of soft clams that have time of year designated by Town Code (§196-15) specifying "commercial harvesting in said specifically designated areas is permitted between the months of September and May, inclusive." Harvest season durations and extents are reevaluated periodically and year-round harvest may not be allowed every year across refuge waters. Current information on harvest season length and duration is found on the Town's website and within Town Code. The refuge will allow the use in coordination with the Town and in alignment with the Town designated seasons and daily hours.

How would the use be conducted?

The Town is proposing to implement a program to restore and maintain viable clam and oyster populations in the estuary, including within the refuge, with a combination of aquaculture, restoration, and natural population regeneration. The Town has indicated to FWS that they would consider future aquaculture, restoration and seeding for soft shell clams. The Town, in coordination with FWS, will implement an adaptive management and monitoring program to track progress of the restoration, adjust actions based on monitoring results, and ensure that shellfish harvesting does not exceed sustainable levels based on monitoring results. The program will include coordination on where aquaculture and shellfishing are allowed, methods and times of the uses, and harvest limits.

All aquaculture and commercial shellfishing activities on the refuge must comply with applicable agency regulations, codes, and requirements of the Town, NYDEC, and any additional requirements/stipulations that are deemed necessary by FWS for the use to be compatible.

A special use permit (SUP) from FWS is required for economic activities under Refuge System policy (50 C.F.R. § 29.1). Specifically, SUPs are required for harvesters that are approved and permitted by the Town and NYDEC and are seeking to perform the commercial harvesting activities described in this CD. Additionally, per 16 U.S. Code § 668dd, FWS is required to issue a permit for refuge special uses and to collect a market rate fee for the issuance of a permit.

As the Town reserves the rights to shellfish and aquaculture activities, FWS will not require the Town or its authorized agents (contractor, nonprofit, non-governmental organization) acting on the Town's behalf to obtain a SUP. The Town is responsible for administering the permits program for authorized aquaculture operators and for commercial shellfishing (separate from FWS SUPs).

Special use permits issued by FWS may include additional stipulations included after close coordination with the Town like specific allowable harvest volumes, and may place limitations on access to, or use of, specific locations of the refuge during specified times in efforts to achieve a sustainable population trend accounting for restoration and aquaculture inputs balanced with harvest extraction. Special use permits will also include reporting requirements including, but not limited to, areas targeted for operations and harvesting, dates and duration of effort expended, and harvest volumes to include size classes. Special use permit holders must also follow any additional stipulations or permit requirements of the Town or State of New York.

Boat operators (both for aquaculture and for commercial shellfishing, which is described in the following sections) are expected to follow Town, State and federal boating regulations. Boats, including the motors and gasoline tanks, are to be kept in good working order to minimize the possibility of an oil or gas spill. A small spill kit should be on board to address a spill in a timely manner. Should a larger spill occur, the operator is required to report the spill to New York State spill hotline for potential remediation.

Aquaculture

The primary aim of the Town's aquaculture program is to manage and restore shellfish populations through estuary-wide restoration activities. The goal is to provide lasting environmental benefits to species' populations, water quality, ecology, and public use of the estuary, along with economic advantages for both the community and the Town. The Town is responsible for maintaining and supporting restorative aquaculture operations. Shellfish aquaculture is ongoing on the refuge, so this section describes current and planned aquaculture practices. Future potential exists for similar techniques to be used for the restoration of additional shellfish species (soft shell clams, scallops, and mussels) on the refuge and are concurrently covered through this CD if future restoration is undertaken for those species. Although the initial phases of the aquaculture program do not occur on the refuge, they are described here for context. The Town procures or grows juvenile shellfish in tanks in their 950-square-foot nursery. The shellfish further develop in off-refuge waters in Floating Upwelling Systems (FLUPSYS). During the 2025 season, the Town seeded 8,477,000 individual shellfish (5,133,000 oysters and 3,343,800 clams) in the estuary. Additional shellfish seed has been and may continue to be sourced from the Cornell Cooperative Extension or other NYDEC-approved sources.

Once the cultured shellfish have matured through the nursery and FLUPSYS, they are seeded in the estuary, including within the refuge boundary, using Town or Town-authorized operator vessels. Vessels shuttle the shellfish to the seeding areas and disperse at low speed. Seeding may occur both within and outside of the refuge. The

Town may also seed with spat-on-shell oysters to promote oyster reef development and adult clams to promote reproduction.

The Town intends to continue placing oyster shells to restore shellfish habitat. Future restoration efforts may include the placement of other substrates to promote shellfish restoration. A variety of substrates have been used in restoration projects and can include stone, concrete, non-oyster shell, engineered reefs and more (Goelz et al. 2020).

Shellfish population monitoring is proposed as part of the Town's program and will include periodic shellfish surveys by a qualified independent party every three years to determine stock abundance, density, and distribution across the estuary complex. Additional field monitoring of planted seeds will collect data on survival and growth rates in different substrates and areas to determine short-term survival rates.

Best management practices (BMPs) and recommendations for site selection and other habitat considerations have been developed by other entities (e.g., East Coast Shellfish Growers Association 2023; Gobler et al. 2022; Hargis and Haven 1999; Long Island Sound Partnership 2025; Marquardt et al. 2025). The Town has demonstrated a commitment to using the best available science, industry standards, and BMPs, such as by considering sediment quality and type in identifying locations for MMAs and SSAs that would best support recruitment and growth of shellfish. These locations offer habitat conditions with a wide range of sediment types suitable for clam growth and survival. Some of these areas also include locations with firmer substrate (e.g. sand, gravel, and shell) that are better suited for oyster growth and survival (Cashin Associates, P.C. 2025).

Any entities performing aquaculture that are not collaborating or partnering with the Town will be required to gain prior approval from the Town and FWS; the Town will be responsible for oversight in coordination with FWS. This methodology aligns with the NYDEC Long Island Shellfish Restoration Project and would utilize a similar cooperative partnership design among stakeholders (NYDEC 2025).

Commercial Shellfishing

Based on the best available information and professional judgement, FWS aligns with the NYDEC's and the Town's commercial shellfishing regulations regarding harvest methods, permits, and limits, but would annually determine in coordination with the Town if increased restrictions are needed based on the results of the Town and FWS monitoring efforts. The following aspects of commercial shellfishing reflect State and Town requirements:

- Commercial harvesters are residents of the Town who have secured a commercial shellfish harvest permit from the Town Clerk and a digger permit from NYDEC.
- Commercial harvesters access harvest areas by motorized boat and may access soft shell clam designated harvest areas by land where lawful access is available. The boats used by the commercial non-mechanical harvesters are 18–

24 feet in length (North Oyster Bay Baymen's Association 2017). They are open deck boats powered by motors. The harvesters may not use motorized power while actively harvesting.

- Methods of harvest vary based on target species and may be influenced by water depth and bottom substrates, but, per Town Code, harvest methods must be non-powered (not operated by power or propelled by a motor) and non-mechanical (gear that is not operated by machinery). Soft shell clams are harvested at low tide.
- The Town stipulates gear restrictions according to species. Gear restrictions can be reviewed in § 196-19 of the Town of Oyster Bay's Town Code. The Town further restricts gear by only allowing one shellfish harvesting device (e.g. rake, tong) to be used per commercial permit endorsed to a vessel. Harvest generally occurs by manipulating shallow bottom sediments with rakes or tongs, extracting shellfish from the sediment and bringing them to the surface. Soft shell clams are harvested by displacing sediment from the intertidal habitat to expose soft shell clams.
- Harvest limits are set by the Town and may be adjusted on an annual basis, and are different for each species. Harvest limits apply to the totality of Town waters for all species of shellfish, not just those waters within the refuge.
- Town Code establishes a limit on the number of commercial permits that can be issued annually and is set at 110 permits. Shellfish permits are valid for one calendar year from the date of issuance. These permits are for the entirety of Town waters and therefore the number of permittees harvesting within the refuge may be fewer.

The Town issued 20 permits in the 2023-2024 permit year, 22 permits in the 2024-2025 permit year, and as of January 2026, 19 permits for the 2025-2026 permit year.

Why is this use being proposed or reevaluated?

The 1968 deed that established the refuge by donation from the Town reserved the Town's right to issue leases, agreements and permits for shellfishing. The deed states that "the conveyance of such lands shall be subject to existing leases and agreements including without limiting leases for piers and shellfish, renewals of leases and agreements covering same, permits for taking shellfish or other products therefrom… provided that…such leases, agreements, renewals, and permits are not incompatible with the use of such lands for a migratory bird refuge, and fish and wildlife purposes." In 1994, FWS issued a single CD for the uses of aquaculture and commercial and recreational shellfishing. These uses were determined to be compatible, with the conclusion that the agency lacked jurisdiction to regulate the shellfish program, citing deed language that reserved shellfish-related rights to the Town.

As reviewed in a previous section, this CD is being issued pursuant to a 2024 settlement agreement for a lawsuit filed against FWS in 2023. The settlement requires that FWS issue a final CD evaluating whether use of refuge lands and waters for shellfish harvesting, including via hydraulic and mechanical dredging, is compatible with the refuge's purposes, as defined by federal law and in the Deed. To satisfy the agreement, FWS is evaluating shellfishing in two CDs: commercial shellfishing and aquaculture (this document) and recreational shellfishing (a separate CD).

While Town Code prohibits hydraulic and mechanical dredging, the settlement requires FWS to include evaluation of these methods. Harvesters holding commercial leases issued by the Town previously used commercial non-mechanical and mechanical methods (including hydraulic dredging within leased lands) in Town waters. The last lease expired in October 2024. To thoroughly evaluate the impacts of past and current harvest methods, FWS has included impacts from these methods in our analysis.

Availability of Resources

To comply with the Refuge Administration Act, as amended by the Refuge Improvement Act (16 United States Code [U.S.C.] 668dd et seq.), and the implementing policy (603 FW 2.11), the Refuge Manager must determine whether sufficient resources—financial, staffing, facilities, or other infrastructure—are available to support the proposed use without materially interfering with the refuge purpose(s) or the mission of the Refuge System. This determination should be informed by a review of current capacity and, where applicable, the refuge's Comprehensive Conservation Plan (CCP).

Assessment of current resources and capacity

Table 2. Costs to Administer and Manage Aquaculture and Commercial Shellfishing

Category and Itemization	One-time Cost	Recurring Annual Expenses
Coordination with Town and partners (staff time to coordinate on management and monitoring program; produce maps; respond to public requests)	$35,400	$9,100
Issue special use permits (estimated 20 permits annually)	$0	$2,000
Supplies, equipment, gas	$3,500	$2,500
Monitoring of potential impacts to migratory birds (breeding and migrating)	$11,500	$5,800

and habitats (staff time and supplies)		
Total expenses	**$50,400**	**$19,400**

Refuge support of aquaculture and commercial shellfishing occurs through the use of existing staff, funding, equipment, and facilities (Table 2). We estimate that the activities described in Table 2 and in the following paragraphs require 364 hours for two refuge employees during the initial phase and 72 hours recurring annually. The estimates in Table 2 were developed using current (FY 2026) salary costs along with anticipated time commitments for the Refuge Manager and the biologist to calculate the totals. Costs are anticipated to increase over time and the annual recurring costs may change.

Each FWS commercial SUP will require a standard $50 application fee. This application fee will cover the current costs for required staff time to review application materials, communicate with permittees, draft permits, and return executed permits. We estimate the minimum time to complete permit issuance tasks to be 30 minutes of staff time investment, arriving at a minimum necessary fee of $50. Fees will be re-evaluated annually, and the website will be updated if changes are made. Current SUP holders would be notified by email or letter of any changes to permit fees or required documentation. Commercial SUP fee revenue will be returned to the refuge to offset costs of administering and permitting the compatible commercial use of the refuge.

The Town is responsible for administering nearly all aspects of the aquaculture and commercial shellfishing program that occurs in refuge waters in compliance with NYDEC requirements and in accordance with refuge stipulations described following the Determination section. The Town is exercising its reserved rights to administer this program, and should the Town no longer desire to engage in this reserved right or end administration of this use under its right, the refuge would not assume the responsibility to administer the program or continue allowing this use.

Refuge resources are required to ensure that the Town administers the use/program in a way that contributes to the achievement of the refuge purpose or the System mission. Recurring refuge staff time can be expected to include:

- Annual consultation with the Town and review of annual reports about the aquaculture and commercial shellfishing program, including harvest.
- Regular consultation with the Town to ensure the aquaculture and commercial shellfishing program is adequately followed and implemented, including ongoing coordination on adaptive management and monitoring strategies.
- Cooperative effort to work with the Town, and potentially other partners, on conducting monitoring that can inform assessment of impacts to wildlife and ecosystems from aquaculture and shellfishing. This may involve shellfish

monitoring; monitoring of migratory birds; and monitoring of potential impacts to habitats and other resources.

- Review of impacts on refuge resources, such as shellfish population levels, scale and scope of substrate additions, changes in bottom sediment characteristics and structure, provided by the Town or other authorities through the monitoring program at least every three years.
- Review and issuance of SUPs for commercial harvesters.

The resources needed to administer this use are currently available. However, adequate levels of refuge staffing, funding, and facilities are necessary to administer this use in a manner that ensures continued compatibility (603 FW2 2.11 (A.2)). Therefore, a reduction in any of these resources may prompt the Refuge Manager to reevaluate the compatibility of this use, and the Refuge Manager may decide to modify or discontinue the use. Impacts of changes to resources and capacity

The availability of resources and the level of use is subject to change. Resources provided may vary based on current staffing, partner support, funding, or infrastructure conditions. Costs may increase over time in relation to changes in the costs, such as for equipment, salaries, or maintaining facilities. A substantial increase to the number of SUP requests may also create the need for additional resources to administer the use. The Refuge Manager will use sound professional judgment in evaluating whether the refuge or its partners can develop, operate, and maintain the use in a compatible manner.

If resource conditions shift such that the refuge can no longer sustain the use in a compatible manner, the refuge manager may modify or suspend the use pursuant to 50 C.F.R. § 25.21. The public will be notified of any changes to refuge uses, including modification or suspension, re-evaluation of compatibility and/or discontinuing of refuge uses.

Refuge staff will consult and communicate with the Town in the event that resource conditions, or resource availability, are compromising the ability to sustain a compatible aquaculture and commercial shellfish program and will seek collaborative solutions or mitigation measures with the Town and partners to the extent feasible to ensure compatibility.

Anticipated Impacts of the Use

Historical and Ecological Context

This section provides a historical and ecological setting of the estuary, emphasizing the importance of the site to those living nearby and to the species and habitats found within the estuary. This section also examines ongoing conservation challenges within the watershed and highlights local efforts aimed at improving conditions for fish, wildlife, habitats, and human use. This section provides an overview of persistent conservation challenges within the watershed and examines ongoing management responses aimed at enhancing ecological integrity and resilience. These efforts are intended to improve habitat quality and ecosystem function for fish and wildlife, while also supporting sustainable human use, including recreational and commercial shellfishing and aquaculture.

History of Shellfishing

The estuary has a long history of shellfish harvesting dating back to the indigenous communities that called this area home before the area was settled by Europeans between 1653 and 1665 (Fuss & O'Neill 2009). Shellfish harvest was achieved in shallow water using short rakes and with modifications to gear over time with the development of hand tongs, basket rakes, bull rakes, mechanical tongs, and finally hydraulic/suction dredges resulting in increased harvest landings (MacKenzie et al. 2002). Prior to World War II, boats used for harvesting were propelled by oars or sails, which were eventually replaced with gas-powered motors.

Shellfish stocks were once so abundant in the Eastern United States that landings between 1900 and 1902 totaled 164 million pounds (MacKenzie et al. 1997). New York was once a leading producer of hard clams; however, large declines in the 1990s were observed (MacKenzie et al. 2002) with specific references to Great South Bay (Long Island), which experienced decreased stocks in the 1970s (Kraeuter et al. 2008). Possible contributions to these declines include overfishing, environmental changes, freshwater inflow, nutrient loading, alteration to forage, increased predation, and decreased recruitment (Kraeuter et al. 2008). Oyster harvests were limited from the 1950s through 1980s due to inadequate supply in New York (MacKenzie et al. 1997); 1991 oyster landings were 85% lower than at the turn of the century for the Eastern United States. By 1994, the Town required that the lease-holders of underwater land seed the leased areas.

Declines in commercial harvests continued in the 2000s. As recently as 2013, oyster harvests in the estuary exceeded 30,000 bushels, according to NYDEC landings reports. By 2017, landings had dropped below 5,000 bushels, and by 2020, fewer than 100 bushels were being harvested per year. The drop in hard clam landings, while not as precipitous, nonetheless has been substantial. Landings exceeded 70,000 bushels every year from 2013 to 2017. Reported harvests have dropped subsequently, with slightly more than 20,000 bushels of hard clams harvested in 2024, the most recent year for which data are available.

The FWS is not aware of any monitoring or long-term monitoring data for blue mussels, bay scallops or soft shell clams. Declines in the reported harvest landings in New York indicate a potential decline of blue mussel populations (NYDEC 2005). Bay scallop populations decreased significantly after eelgrass (*Zostera marina)* die off due to wasting disease in the 1930s and again after brown tide events in the 1980s (NYDEC 2013). Eelgrass meadows provide important nursery and settlement sites for bay scallops. Annual harvest landings for soft shell clams in the estuary have been variable since 2000, ranging from zero bushels to a high of 365 bushels in 2009. Unlike all other historically commercially harvested shellfish species in the estuary where a declining trend in harvest landings may indicate a decline in the stocks, the same inferences cannot be made with soft shell clams. For soft shell clams, commercial harvest effort is low, intermittent, and variable leading to landing numbers more reflective of the intermittent harvest effort than linked to a population trend. While there is no clear trend of population decline, the low harvest volumes may indicate a scarcity of soft shell clams available for harvesting in years when harvest reports were low. Conversely, the low harvest landings may indicate a lack of effort, or interest, in harvesting soft shell clams. The Town has indicated that its monitoring program will incorporate soft shell clams, which could provide more insights on the population in the refuge.

Ecological Designations

Several designations highlight the importance of the estuary for fish, birds and wildlife.

Through its Coastal Management Program, the State of New York considers Oyster Bay to be a Significant Coastal Fish and Wildlife Habitat (New York State Department of State (NYSDOS) 2005a; 2005b). The estuary is considered an important waterfowl wintering area from November through March for greater scaup (*Aythya marila*) and lesser scaup (*A. affinis*), American black duck (*Anas rubripes*), canvasback (*Aythya valisineria),* common goldeneye (*Bucephala clangula*), and a number of other waterfowl species based on mid-winter aerial surveys conducted from 1986 to 1996 and 1998 to 1999 (NYSDOS 2005b). The estuary is an important area for marine finfish and shellfish, including several species that are identified by NOAA Fisheries Essential Fish Habitat (EFH) Mapper. Oyster Bay, including Mill Neck Creek, is a recognized EFH that serves as a nursery and habitat for 29 species including scup (*Stenotomus chrysops*), bluefish (*Pomatomus saltatrix*), Atlantic silverside (*Menidia menidia*), Atlantic menhaden (*Brevoortia tyrannus*), winter flounder, and blackfish (*Tautoga onitis*) (EFH Mapper).

Oyster Bay is also identified as a State Priority Important Bird Area by the National Audubon Society (2025). The estuary is located within the Long Island Sound watershed, a designated “Estuary of National Significance.” National estuaries are established to protect and restore water quality and ecological integrity.

Habitats and Wildlife

Benthic (bay bottom) communities perform important ecological functions including cycling of nutrients, providing structure and habitat for other organisms, supporting planktonic food web interactions, and creating prey for predators such as birds and bottom-dwelling fishes (Flanagan et al. 2019). Among the benthic organisms, oysters, clams, and other bivalves are noteworthy in their ecological contributions. As reviewed in Coen et al. (2007), Gobler et al. (2022), and Long Island Sound Partnership (2018), bivalves serve as “ecosystem engineers” that provide several important ecosystem services. First, oyster reefs and clam beds serve as habitat (Coen et al.

2007), foraging grounds, and food for crabs and other invertebrates, fish, and birds (Long Island Sound Partnership 2018). Second, they perform substantial filtering of bay waters, removing suspended solids, nutrients, and phytoplankton from the water column (Gobler et al. 2022, Coen et al. 2007, Long Island Sound Partnership 2018). When present in sufficient numbers, they can thereby improve water quality and clarity. This can help in controlling harmful algal blooms and facilitate the growth of submerged aquatic vegetation (SAV) (Gobler et al. 2022). Third, oyster reefs can protect shorelines from storms, supporting the growth of tidal marsh and SAV (Long Island Sound Partnership 2018). Finally, they support substantial commercial and recreational fisheries (Long Island Sound Partnership 2018). Over the past 150 years, bivalve populations have declined across the eastern seaboard including Long Island, and efforts are underway to restore their populations.

Meadows of eelgrass (*Zostera marina*), historically the most abundant SAV in Long Island Sound, are also an important component of the estuarine systems that have undergone significant declines over the past century. The two historically mapped locations of eelgrass meadows within the estuary are no longer present (Long Island Sound Partnership 2003). Eelgrass meadows create structure, act as a nursery and settlement site for fish and shellfish, and are a food source to numerous estuarine and marine species including waterfowl (Carroll et al. 2008) and green sea turtles (*Chelonia mydas*).

Impact Analysis

The effects and impacts of the proposed use to refuge resources and refuge purposes, whether adverse or beneficial, are those that are reasonably foreseeable and have a reasonably close causal relationship to the proposed uses of aquaculture and commercial shellfishing. This CD analyzes the environmental consequences on a resource or refuge purpose only when the impacts on that resource could be more than negligible and therefore considered an “affected resource.” For example, considerations such as air quality or noise impacts, deemed negligible, are not analyzed in this CD.

The impact analysis evaluates aquaculture and commercial shellfishing for oysters and clams because those are the species that the Town is currently planning to restore and that have historically (and recently) been most important for commercial shellfishing. No commercial harvest for scallops or mussels has been reported to NYDEC since 2017. Populations of scallops and mussels are currently estimated to be prohibitively low on the refuge to be considered as viable or compatible for commercial harvest under current conditions, and there are no planned aquaculture measures to restore the population. Therefore, additional harvest impacts for these species are not considered further in this analysis as they would be non-existent as they will not be harvested at the present time. Restorative aquaculture and seeding for scallops and mussels would likely have similar impacts to those covered here for hard and soft shell clams and oysters, and the CD covers any future potential restorative aquaculture for those species.

To aid understanding, we divide the analysis into different sections before providing an overall synthesis of how these uses may affect the refuge's purpose and resources in section 4. Sections are organized as follows:

A. **Aquaculture vs. commercial shellfishing impacts.** The impacts of these uses are understood to be distinct, so they are analyzed separately. Within commercial shellfishing, we separately analyze non-mechanical harvesting (a current use) and mechanical harvesting (not practiced since 2024), where possible.

B. **Physical (section 1), chemical (section 2), and biological (section 3) impacts.** Physical characteristics include the physical structure of the bottom sediment and quantity of particles (turbidity) in the water column. Chemical characteristics include the quantities of nutrients and contaminants in the water column and sediment. Biological characteristics include abundance, condition, diversity, and interactions of fish, wildlife, and plants present within the refuge. We introduce each of these sections with a table summarizing potential impacts from aquaculture and commercial shellfishing.

C. **Literature review vs. anticipated impacts within the refuge.** Few scientific studies have been published on the impacts of aquaculture or shellfish harvesting within the refuge. Therefore, we also consider the best available information on impacts studied and documented in similar habitat and ecosystem types to draw inferences on potential impacts within the refuge. This information is summarized in "literature review" sections. We then conclude sections 1, 2, and 3 with an analysis of potential impacts of both aquaculture and commercial shellfishing within the refuge, drawing from Oyster Bay specific information (such as Cashin Associates, P.C. 2023; 2025; Mueller 2023) where available.

D. **Direct vs. indirect impacts.** Direct effects refer to the initial, immediate impacts of a use, such as an increase in abundance of shellfish due to aquaculture seeding. Direct effects can lead to chains of indirect effects interacting with each other, such as the effects that shellfish have on water quality (chemical effects) and their predators (biological effects), over both short- and long-time scales (which we distinguish where relevant). We include a separate section on indirect effects of commercial shellfishing, and synthesize both direct and indirect physical, chemical, and biological impacts within section 3.1 and the concluding section 4. Section 3 focuses on impacts most relevant to the purposes for which the refuge was established.

Aquaculture

Impacts identified below represent our current understanding of potential impacts of this use based on review of current scientific literature and professional judgment.

Factors influencing shellfish aquaculture are highly context-dependent, including variables like population density, reef heights, estuarine flushing rates, and sediment substrate composition (Ayvazian et al. 2020, Gobler et al. 2022, Lenihan and Peterson 1998). Aquaculture practices and methodologies are described in the "how will the use be conducted" section.

Commercial Shellfishing

The physical, chemical, and biological impacts of shellfish harvesting, and commercial harvesting specifically, are highly variable depending on many factors (Boese 2002; Heffernan 1999; Mercaldo-Allen and Goldberg 2011; Thrush and Dayton 2002). Impacts vary depending on the organisms considered; for example, some animals can easily evade harvesting activities and recolonize following disturbance, whereas other, less mobile organisms may be much more sensitive. Impacts also vary depending on the frequency, duration, intensity (number of harvesters, areal extent and depth of harvesting activities) and efficiency of harvest effort; the physical nature of the substrate (bottom); and the types of tools used by the harvesters.

Commercial non-mechanical harvest methods are described in the "how will the use be conducted" section. Although hydraulic dredging is not allowed by the Town, dredging impacts are evaluated to satisfy the settlement agreement and to address the possibility of future changes in Town Code. Commercial mechanical harvest methods include the use of a dredge which is towed by a vessel under motorized power. To make industrial commercial shellfishing harvesting more efficient, save manpower, minimize damage to the shellfish, and control predators, several companies modified dredges for the use of shellfish harvesting (NOAA 1948). Until the lapse of the lease in September 2024, harvest of shellfish on the leased lands was accomplished with the use of a vessel with a Venturi suction dredge and five vessels with a harvest sled equipped with a hydraulically assisted harvesting scrape and basket (U.S. Army Corps of Engineers (USACE) 2022). A suction dredge pulls material from the bottom of the bay and deposits it on a chain mesh conveyor that sorts for objects less than one inch in diameter and returns them to the water with a separate conveyor (USACE 2022). The towed sled used for the harvest of hard clams reaches a depth of 3.5 inches, equipped with water jets that push water to the cutting edge of the blade to propel clams into the basket (USACE 2022).

1. Physical Effects

Physical effects include all potential impacts from aquaculture and commercial shellfishing to the physical structure of the bottom sediment and quantity of particles (turbidity) in the water column; effects may be short-term (hours to weeks) or, as may result from a sustained restoration program, long-term (months to years) in duration. Table 3 summarizes these impacts, which are further discussed in the remainder of section 1.

Table 3. Summary of anticipated physical impacts.

Use	Impacts (+/-)	Duration
Aquaculture	Creation of complex, vertical structure (reefs, beds) that can serve as habitat for invertebrates and fish across the estuary (+)	Long-term
Shellfishing	Localized sediment disturbance resulting in changes to substrate and turbidity (-)	Short-term
Shellfishing	Localized loss of vertical structure (-)	Long-term

Summary of Anticipated Physical Impacts – Net Positive

The aquaculture program is expected to significantly benefit the estuary by restoring a crucial and long-absent habitat, thus enhancing the overall health and biodiversity of the ecosystem. Any negative impacts of converting soft bottom habitat to oyster reefs or beds are expected to be minor in comparison. Shellfish harvesting could have some short-term water quality impacts and long-term effects on the estuary bottom, including loss of vertical structure (once restored) annually in a small area. In total, shellfish restoration through aquaculture and effective harvest management will improve physical habitats across the estuary, providing overall net benefits.

1.1 Literature Review of Physical Effects from Aquaculture

Increasing shellfish populations may substantially benefit the physical structure of estuarine ecosystems. For example, increasing oyster populations restores oyster reefs, which in turn provide complex, three-dimensional structure that can serve as habitat for a variety of organisms that dwell or feed on the bottom (Ayvazian et al. 2020; 2022; Dumbauld et al. 2009). Oyster reefs can also protect shorelines from storms, mitigating erosion and sustaining tidal marshes and SAV (Scyphers et al. 2011). Though not as obvious as for oyster reefs, clam shells may also contribute to surface structure of the bottom (Dumbauld et al. 2009). At the same time, restoring shellfish beds will displace existing bottom habitat for some species, with impacts depending upon the spatial area of the restoration (Dumbauld et al. 2009).

1.2 Literature Review of Physical Effects from Commercial Shellfishing

Sediment disturbance

Commercial harvest of shellfish is carried out through use of equipment with teeth that drag along the surface layer of sediment or tools like shovels which are used to dig to a certain depth, dislodging shellfish and disturbing sediment. Shellfish that live deeper in the sediment require greater effort and disturbance to harvest, resulting in a greater sediment plume. Oysters live above the sediment surface, and adult hard clams generally reside in the top two inches of sediment (Doering 1982), whereas soft shell clams reside deeply buried (Hanks 1963) in the sediment. Adult soft shell clams reside in the sediment up to depths of 30cm (Abraham and Dillon 1986). Sediment disturbance from harvesting of soft shell clams is expected to be greater than from harvest of the other species due to their typical residence depth. Following harvest operations, sedimentation occurs as suspended sediments or sediment plumes are transported by currents away from the area of disturbance and fall to the seafloor. Sediment disturbance is greatest closest to the disturbance site and dissipates as sediments settle with large grain size settling close to the disturbance and smaller sediments resulting in a sediment plume that is carried farther afield (Mercaldo-Allen and Goldberg 2011). In a review of shellfish dredging impacts, Mercaldo-Allen and Goldberg (2011) found reported elevated turbidity and sediment plumes could extend 50-100 feet away from the dredging activity. A variety of factors including equipment type, sediment grain size, current characteristics, and site geomorphology will affect the severity and impacts of turbidity and sedimentation (Coen 1995; LaSalle 1990). Sedimentation and elevated turbidity can negatively affect many marine organisms, as discussed in section 3, “Biological Effects.”

Changes to physical structure of substrate

Abrasion and excavation of the seabed may change the physical structure of the substrate, which constitutes habitat for a variety of organisms (Mercaldo-Allen and Goldberg 2011). Alteration of sediment and vertical structure may negatively impact organisms through the loss of suitable habitat for larval settlement, foraging habitat, and removal of fauna (Dernie et al. 2003). Additionally, impacts to soft bottom substrates can lead to disturbance of microbial and microalgal communities and resuspend sediments leading to mixing of sediment grain sizes (Dernie et al. 2003). Removal of these structures can result in species settling in less optimal habitats (Lenihan and Peterson 1998).

Lenihan and Peterson (1998) found that oyster reefs degraded by dredge and mechanical tongs exhibited decreased reef height and increased mortality of oysters observed at depths of 6 m due to low oxygen conditions.

Trampling of the substrate by harvesters may compact the sediment, altering its porosity and penetrability. Walking on intertidal mudflats can impact organisms by crushing or displacing them, resulting in competition and predation, and by destroying burrows and disrupting benthic biofilm (Rossi et al. 2007). On the other hand, harvesting activities on otherwise relatively homogenous tidal flats might create a more complex microtopography by providing structural diversity.

1.3 Analysis of Physical Impacts within the Refuge

The degree of physical effects, and associated chemical and biological effects, will depend on the extent and degree of shellfish restoration, as well as the extent and methods of commercial harvesting associated with restored shellfish populations. The Town has designated 151 acres of the refuge (~5%) as no-harvest SSAs, with an additional 342 acres (~10%) designated as MMAs for shellfish restoration that could allow future shellfish harvest. Recognizing that the estuary no longer contains wild oyster reefs (Fuss & O'Neill 2009) and that hard clam populations have vertical structure decreased, the restoration areas could have substantial benefits to the estuary. The potential for the sanctuary and management areas to serve as sources of eggs and larvae holds promise of dispersing shellfish with their beneficial impacts beyond the management areas. As described in "Biological Effects," the enhancement of vertical structure and complexity described above has the potential to benefit many species of fish and wildlife, including migratory birds for which the refuge was established, while meeting a core component of the Refuge System mission of habitat restoration. Positive impacts may be long-lasting if oyster reefs and clam beds are sustained.

The extent and potential physical impacts of non-mechanical harvesting in the estuary have been investigated by Cashin Associates P.C. (2023) and Mueller (2023). During a 2023 field investigation (September-October), Cashin Associates did not observe more than ten commercial non-mechanical harvesters operating concurrently, with five to eight commercial baymen at any given time being the norm. Powered by sails and tide sheets, the baymen rock a harvesting rake back and forth to move through the sediment. When the rake or other tool is pulled up to the surface, a sediment plume is formed as sediment is washed out of the rake. The area disturbed and extent of the plume varies depending on sediment type and characteristics of the raking tools, with sediment disturbance likely to be greater in soft bottoms or mud than in areas with a hard bottom. The Cashin Associates and Mueller studies found that most of the estuary bottom consists of a mixture of the three sediment classes – mud, sand, and gravel (including shell) – with the former lease areas containing relatively greater proportions of sand and gravel, while the unleased areas open to non-mechanical harvesting have greater proportions of mud. Mueller (2023) found that non-mechanical shellfishing generated linear depressions extending 0.3 m (about one foot) deep. The total area of bottom affected was estimated to be 0.55 km^2 (136 acres), much of which was in the refuge. Future commercial harvesting would be expected to continue to generate shallow sediment tracks; while we anticipate this is a short-term negative impact, their extent and persistence would depend on factors such as the intensity and location of harvesting activities. Organisms of the intertidal zone (and adjacent areas) are adapted to dynamic conditions and generally can tolerate some degree of disturbance (Hinchey et al. 2006, Kaiser et al. 2001).

Mechanical harvest techniques, such as formerly practiced mechanical dredge operations, are anticipated to have much more intensive impacts to sediment structure than non-mechanical harvesting given the use of powered boats with a hydraulic dredge unit employing water jets to move hard clams into a cage. The USACE permit (NAN-2020-00422-EBR) indicates that the mechanical dredge operators would harvest 200 acres of the leased lands in any given year. Dredging intensity in the leased lands could consist of multiple boats at the same time performing dredge tows for several hours a day (Mueller 2023). While only 200 acres were typically targeted for dredge per year within the leased lands, Mueller (2023) calculated the area exhibiting evidence of mechanized dredge activity (dredge tracks) to be 4.01 km^2 (991 acres), the majority of which was in the refuge; the study suggests dredge tracks are additive across years and are evident for at least five years. Dredge tracks were wider and deeper than non-mechanical tracks and appeared to persist for months to years. Mueller also determined that the extent and severity of dredging could be more likely to lead to fine-sediment deposition compared to non-mechanized clam raking, with hydraulic shellfish dredging potentially leading to fine-sediment deposition at least 8 to 30 m away from dredge sites in the shallow waters of Oyster Bay Harbor, and possibly hundreds of meters. In low energy environments such as those of Oyster Bay, dredging has potential for long-term alteration or loss of sediment, although natural events could also be responsible for observed changes (Mueller 2023). As described in the section on biological effects, alteration in sediments and turbidity caused by dredging may adversely affect marine species.

Aside from the harvest equipment, boats (and their gear) used in non-mechanical commercial shellfishing are not expected to have significant physical impacts due to their relatively small size and their operation in waters deeper than three feet. Similarly, vessels will be used for aquaculture only in deeper water and will be in operation relatively infrequently, limiting impacts.

Harvest of soft shell clams is expected in waters less than three feet deep, where organisms are adapted to more dynamic conditions and may be more tolerant of disturbance (Hinchey et al. 2006, Kaiser et al. 2001). High energy systems are expected to recover more quickly from disturbance than low energy systems, recovering in a matter of days vs. months in the case of shellfish dredging (Mercaldo-Allen and Goldberg 2011). Oyster Bay is considered a low to moderate energy system (Mueller 2023). The FWS concludes based on currently available landings data for soft shell clams that soft shell clam commercial harvest is performed intermittently and to varying intensities within the Town waters. The use is likely to have minimal impacts (whether positive or negative) on the refuge's physical structure, if it is conducted according to the stipulations provided in this compatibility determination. If subsequent information indicates that commercial soft shell clam harvesting is having more than negligible impacts, the compatibility of this use may require reevaluation.

2. Chemical Effects

Chemical effects include all potential impacts from aquaculture and commercial shellfishing to the quantities of nutrients and contaminants in the water column and sediment. These include short- and long-term impacts to water clarity and nutrient levels, influencing the water quality of the estuary. Table 4 summarizes these impacts, which are further discussed in the remainder of section 2.

Table 4. Summary of anticipated chemical impacts.

Use	Impacts (+/-)	Duration
Aquaculture	Increased water clarity across the estuary (+)	Long-term
Aquaculture	Reduced water nutrient levels across the estuary (+)	Long-term
Shellfishing	Localized reduction in water clarity (-)	Short-term
Shellfishing	Localized increased water nutrient and contaminant levels (-)	Short-term

Summary of Anticipated Chemical Impacts – Net Positive

Overall improvement to water quality is expected through reduction in water nutrient levels and turbidity from the filtering action of restored shellfish populations. With sustained aquaculture and managed harvests, shellfish populations are expected to increase over time, potentially resulting in long-term nutrient reductions.

2.1 Literature Review of Chemical Effects from Aquaculture

Shellfish filter large volumes of water, which can improve water clarity and reduce nutrient levels (Barr et al. 2024; Ray and Fulweiler 2021). Lower nutrient levels can mitigate harmful algal blooms and improve conditions for other marine life (Newell 2004; Searles et al. 2022). Oyster reefs also promote efficient nutrient cycling (Ray and Fulweiler 2021). Therefore, shellfish restoration has the potential for chemical effects that are regarded as largely positive.

The effectiveness of filtration is highly variable, however, depending on local conditions including bivalve population densities and estuarine flushing rate. If population densities are too low, water filtration capability is reduced and associated benefits to water quality, biodiversity, and sediment stability and content may diminish (Turner et al. 2019). Conversely, if population densities become too high in a location, capability of sediments to maintain nitrification processes may be overwhelmed. This leads to depletion of oxygen and disruption of normal benthic processes (Rice 2008). Measurable reductions in particulate pollutants may only be achievable in smaller, closed systems (Kreeger et al. 2018).

2.2 Literature Review of Chemical Effects from Commercial Shellfishing

Sediment disturbance in estuarine environments can remobilize nutrients and contaminated sediment from the bay bottom to the water column; additionally, algae using elevated nutrients can deplete local oxygen (Coen 1995; LaSalle 1990; Roberts 2012). If excessive, harvest of shellfish could be anticipated to dampen the multiple positive effects of filtration of the water column described above for shellfish restoration, including reduction in nitrogen and other nutrients. Effects could be short-term if population reductions were brief, or long-term if shellfish populations did not recover.

2.3 Analysis of Chemical Impacts within the Refuge

Shellfish restoration, such as long-term hard clam restoration that included spawner sanctuaries (no harvest zones with high adult clam density) in another region of Long Island (Gobler et al. 2022), has been demonstrated to have measurable improvements in water clarity and reductions in harmful algae. Such findings offer qualified support for benefits to water quality of the estuary from shellfish restoration, thus enhancing refuge ecological health and integrity, in alignment with the Refuge System mission. These positive impacts may be long-term if healthy shellfish populations are sustained. Quantitative predictions of the effects on water quality of the estuary from shellfish restoration would require more information on factors such as shellfish density, filtration rates, and estuary water circulation patterns.

Realizing these benefits requires both effective restoration and ensuring that shellfish harvesting does not offset the resulting water quality gains. Imposing limits on harvesting, and restricting methods of take, are mechanisms that could reduce negative impacts.

Motorized boats used for aquaculture operations and commercial shellfishing also have the potential for chemical impacts. Boating can negatively affect wildlife through minor effects including water pollution from exhaust gases and spilled fuel. Motors may not be used during active shellfish harvesting (only during conveyance to the harvesting site), which should reduce the risk of fuel discharges. Vessels used for aquaculture will be in operation relatively infrequently, limiting risk of fuel discharges. Measures should be implemented by boaters to prevent spills such as proper maintenance of outboard/inboard engines and carrying appropriate supplies to effectively clean up unintended spills or leaks.

3. Biological Effects

Biological effects include all potential impacts from aquaculture and commercial shellfishing. These include short- and long-term impacts, both direct and indirect, to target and non-target species. Direct impacts include changes to shellfish populations through restoration and removal of target species, impacts to non-target species through removal of bycatch, injury or death, and disturbance of wildlife. Indirect effects result from direct physical, chemical, and biological impacts. Indirect effects include changes to biodiversity, species composition, and community structure due to alterations in food web interactions, habitat availability, and quality. Table 5 summarizes these impacts, which are further discussed in the remainder of section 3.

Table 5. Summary of anticipated biological impacts.

Biological – Direct Effects

Use	Impacts (+/-)	Duration
Aquaculture	Increased shellfish populations across the estuary (+)	Long-term
Shellfishing	Localized removal of targeted shellfish and non-targeted bycatch (-)	Short-term
Shellfishing	Localized crushing, injury, burial, and exposure of wildlife and plants (-)	Short-term
Shellfishing	Localized disturbance of wildlife including fish and birds (-)	Short-term

Biological – Indirect Effects

Indirect effects to organisms are a result of the direct physical, chemical, and biological effects.

Use	Impacts (+/-)	Duration
Aquaculture	Improved shellfish habitat and shellfish populations across the estuary (+)	Long-term
Aquaculture	Increased habitat diversity, which benefits fish, birds, and other wildlife across the estuary (+)	Long-term
Shellfishing	Localized impacts to habitat for shellfish (-)	Long-term
Shellfishing	Localized changes to biodiversity, species abundance and composition, and community structure (-)	Long-term
Shellfishing	Localized altered predator/prey interactions (-)	Short-term

Summary of Anticipated Biological Impacts – Net Neutral to Positive

Shellfish restoration through aquaculture with an effectively managed harvest program can benefit the estuary. These practices, when successful, will increase shellfish populations and positively impact marine plants, fish, and wildlife, resulting in a healthier ecosystem. Negative effects from commercial shellfishing can be minimized through effective harvest management informed by monitoring and through the implementation of BMPs, ensuring a net benefit to the estuary.

3.1 Literature Review of Direct and Indirect Biological Effects from Aquaculture

Food web interactions and impacts to other species

An aquaculture program is intended to increase shellfish populations, a direct biological impact on the ecosystem. As noted previously, bivalves can serve as ecosystem engineers that substantially alter the physical and chemical environment, with indirect benefits to the other species that inhabit the area. Notably, oyster reefs are important nursery habitat for juvenile fish and are associated with high fish species diversity and fish densities (Ozbay et al. 2017). Oyster reefs have also been associated with increased populations of crabs and other marine invertebrates

(Peterson et al. 2003; Searles et al. 2022). Oyster reefs are prime settling habitat for larval oysters, thus potentially resulting in a positive feedback loop from oyster restoration (Breitburg et al. 2000). Lehnert and Allen (2002) found that shells on subtidal bottoms could be essential habitat for juvenile species and foster a diverse assemblage of fishes and crustaceans.

Limited information is available on direct impacts of shell placement for aquaculture on benthic organisms, but it is plausible that some injury could occur. Less mobile and less robust species and life stages, such as eggs of species like winter flounder that lay their eggs on the bottom, would be more susceptible.

Research has shown a mutualistic relationship between bivalves and SAV communities, such as eelgrass (Carroll et al. 2008), and therefore shellfish restoration could play a role in facilitating reestablishment of SAV in places where it has been extirpated, such as Oyster Bay. Clams and oysters benefit from eelgrass communities as juveniles are provided with structure in which to grow and shelter from predators, and eelgrass (and other SAV) helps to provide sediment stabilization and oxygenation. Additionally, healthy and productive shellfish beds may provide optimal conditions for eelgrass growth and bed expansion (Carroll et al. 2008), another indirect impact of shellfish restoration. Population increases in shellfish, crustaceans, fishes, and aquatic vegetation due to shellfish restoration may benefit a variety of bird species that feed on these resources. Such indirect biological impacts are expected to outweigh potential direct negative impacts such as temporary disturbance of waterfowl during seeding operations. The timing of aquaculture operations (estimated to be June to October) does not overlap with the presence of wintering waterfowl (typically November through March) reducing the likelihood of any disturbance occurring. Additionally, active aquaculture seeding and substrate placement during active migration periods will be limited and infrequent, reducing the potential for disturbance to migratory birds. Low levels of estimated disturbance from aquaculture practices during migration and overwintering is important given the refuge's purpose of protecting migratory birds.

Disease spread

Artificially concentrated populations of shellfish sometimes found in aquaculture operations can create conditions favorable for the spread of pathogens and parasites, which may adversely impact not only the cultivated species, but also wild populations (Paillard et al. 2004). Ford et al. (2002) found a significant trend between higher planting densities and increased Quahog Parasite Unknown (QPX) levels, highlighting the importance of following current research and industry standards for seeding at reasonable rates backed by monitoring. Using non-local sources for bivalve seeding stock risks the introduction of parasites (O'Shaughnessy et al. 2014); thus, seeding stock has been and should continue to be procured from sources as close as feasible locally or regionally when possible, but must be sourced from a NYDEC approved vendor. If direct negative impacts to shellfish populations from disease were not prevented or contained, it could lead to further negative indirect impacts to fish and wildlife that benefit from healthy shellfish populations.

Introduction of invasive species

Invasive species may have significant impacts on terrestrial and marine ecosystems. While the aquaculture species covered in this CD are native, care should be taken to align with best management practices preventing invasive species, such as biofouling sea squirts (tunicates) (Carman et al. 2010), from being introduced via contaminated equipment. As in the case of shellfish disease, invasive species pose a risk of direct negative biological effects to shellfish and indirect effects to other fish and wildlife.

3.2 Literature Review of Direct and Indirect Biological Effects from Commercial Shellfishing

Shellfish harvesting may have both direct and indirect effects on organisms. Migratory birds and other vertebrates may be more affected by indirect than direct effects, but indirect effects are more difficult to assess because of the complexity of marine food webs and the variety of factors other than shellfishing that simultaneously affect marine organisms. A consistent theme in the shellfishing literature is that biological impacts are highly dependent on the specific location and harvest scenario considered as well as the characteristics of the organism. Even if an impact has occurred in one locale, that does not guarantee that it will occur at another, demonstrating the need for long-term site-specific information to accurately assess impacts.

Direct biological effects – removal of targeted shellfish and non-targeted bycatch

Commercial shellfishing will reduce the adult shellfish population in the local harvest area. The significance and duration of such a reduction depend on several important factors, such as the intensity of shellfishing pressure, shellfish density, and quality of habitat. If local shellfish density is high such that individual shellfish are competing with each other for space and resources, then removal of large shellfish could benefit remaining shellfish and shellfish larvae that can take advantage of the newly available resources and available habitat (Mercaldo-Allen and Goldberg 2011, Leavitt and Fraser 2004).

Mercaldo-Allen and Goldberg (2011) identified evidence of positive impacts from mechanical and hydraulic shellfish dredging, resulting in shellfish enhancement as a function of algae and silt removal and increasing available shell and sand within the dredge track for shellfish spat settlement. The ability of larval shellfish to recolonize an area also depends on factors such as predation pressure by crabs and other predators. Smaller clams that reside at shallow depths may be resuspended during harvest efforts (in addition to other disturbance factors) which could lead to resettlement and transport of young clams (Dunn et al. 1999) and can influence recruitment and survival.

Bycatch refers to the unintentional capture of organisms during a harvest practice targeted at other species. There is limited literature available on the bycatch resulting from non-mechanical harvest. Fish and other mobile organisms should be able to evade hand tools, although more sessile and delicate organisms could be injured during the harvest process. In the case of dredging, impacts have been documented, but bycatch generally is not collected or reported. Even when bycatch is returned to the water, injury and mortality may occur depending on the type of gear used, water oxygen levels, and surface temperatures. Smaller bivalves, with thinner shells, may be more susceptible to damage or mortality as a result of shellfish dredging for hard clams or oysters (Mercaldo-Allen and Goldberg 2011).

Direct biological effects – crushing, injuring, burying, or exposure of biota (Literature review continued)

Shellfish harvesting can affect benthic communities by directly injuring or displacing organisms in the path of the gear. Injuries, displacement, or removal of sediment, even if not fatal by themselves, may attract predators that can more easily access the affected prey (Mercaldo-Allen and Goldberg 2011). Organisms that live within and on top of the sediment will be most vulnerable, especially less mobile and less robust species and life stages, including eggs. Munari et al. (2006) found that non-mechanical raking resulted in changes to the macrobenthic community (which consisted largely of polychaete worms) but benthic organisms were able to recolonize raked areas relatively rapidly. Eelgrass provides habitat for these organisms. If eelgrass were to be restored on the refuge, raking could potentially adversely affect eelgrass beds. Use of rakes to harvest shellfish within eelgrass beds has been found to cause a loss in eelgrass biomass, with the severity depending on the type of rake used (McLaughlin et al. 2007; Peterson et al. 1987). Commercial dredging may have more severe effects than non-mechanical raking. Following commercial shellfish dredging, eelgrass beds may take more than five years to recover (Cole 2016; Neckles et al. 2005).

Horseshoe crabs (*Limulus polyphemus*), which are important components of coastal ecosystems, may be injured during mechanical shellfishing. These injuries can lead to mortality or diminished reproductive success (Smith et al. 2017). Impacts are of concern because horseshoe crab eggs and larvae are a critical component of the diet of shorebirds on their northward migration (Beekey et al. 2013; Bopp et al. 2019), especially the federally threatened red knot. Adult horseshoe crabs are also important prey for endangered sea turtles and are predators of benthic organisms.

Demersal fish species, like flounder, are particularly vulnerable to dredging activities as they reside on or in the bottom substrates with life-history strategies of burrowing or hiding in the bottom substrate (Nightingale and Simenstad 2001). Winter flounder eggs are especially susceptible to destruction or burial from dredging as they are clustered on the substrate surface. Demersal species may be injured by hydraulic water jets or dredge teeth.

Direct biological effects - disturbance of behavior (Literature review continued)

Disturbance can be defined as human activity that alters the normal behavior of an organism, resulting in increased energy expenditure and potentially reducing productivity and survival rates (Knight & Gutzwiller 1995; Mengak & Dayer 2020). Commercial shellfishing is likely to cause some impact to wildlife from disturbance. Among the bird species potentially affected, waterfowl and gulls are present year-round on the refuge, with numbers peaking from December to March (USFWS 2006). Terns and osprey feed on fish in open waters during warmer months. Effects to birds are described in more detail in the following section. Other species including fish and marine species may experience disturbance from activities in the estuary.

Boating can be a source of disturbance, with the degree depending on the species, time of year, behavioral activity, level of visitation, boat type, boat operator, and the juxtaposition of boaters and wildlife (DeLong 2002). Potential impacts include general disturbance such as flushing of birds and behavioral changes as well as nest disturbance, direct and indirect mortality, nest abandonment, and habitat destruction from boating (Bouffard 1982; DeLong 2002; Knight and Cole 1995; Knight and Gutzwiller 1995; Purdy et al. 1986). Passing boats may also decrease fish abundance or otherwise impact communication and behavior among fish (Becker et al. 2013; Whitfield and Becker 2014). These types of disturbance are temporary and generally localized and may vary depending on wildlife species or type of bird (Batten 1977). Disturbances to wildlife and other harvesters by non-motorized boats are generally less than motorized activities due to the quiet nature of non-motorized boating, and generally low volume of use in any given area.

Direct biological effects - disturbance of birds (Literature review continued)

Many shorebirds that nest, migrate, or overwinter in the United States are in decline and are of conservation concern due to threats and pressures they experience throughout their annual cycle. Since 1970, shorebird abundance across North America has declined by 37% (Rosenberg et al. 2019), and those declines are accelerating over time (Smith et al. 2023). Human disturbance has been identified as a major threat and a key mortality source for shorebirds, especially in the Northeastern U.S. (AFSI 2015; NABCI 2022). Disturbance can be defined as “a human activity that causes an individual or group of shorebirds to alter their normal behavior, leading to an additional energy expenditure by the birds. Disturbance disrupts, and can prevent, shorebirds from effectively using important habitats and from conducting the activities of their annual cycle that would occur in the absence of humans (Burger et al. 2004). Productivity and survival rates may also be reduced" (Mengak and Dayer 2020). Human disturbance can be caused by both intentional and unintentional actions, including commercial soft shell clam harvesting activities, and disturbance can impact shorebirds during spring and fall migration and during breeding. During the breeding season, disturbance can affect how shorebirds use habitat, as well as their reproductive success and survival. Human disturbance has been found to exclude shorebirds from habitat they would otherwise use for nesting and to cause adults to incubate or attend their nests less frequently, which can result in reproductive failure when nests are left unprotected from temperature fluctuations or predators (Lafferty et al. 2006; Sabine et al. 2008). Additionally, human activity can cause direct mortality of adults, chicks and eggs, such as trampling (Melvin et al. 1994; Ruhlen et al. 2003; Schulte and Simons 2015).

Disturbance during the non-breeding season, which involves a period of migration, can also have significant impacts on the survival and fitness of shorebirds. Migration is an energetically demanding activity that requires sufficient food resources and stopover sites where birds can rest and forage, and many such stopover sites occur in the Northeastern U.S. (Colwell 2010; Linscott and Senner 2021). Disturbance can cause shorebirds to fly away, displace them from important habitats, and reduce their foraging time and feeding rates (Burger et al. 2004; Burger and Gochfeld 1991; Burger and Niles 2014; Navedo et al. 2019; Pfister et al. 1992). The cumulative result of these impacts can be a severe energetic cost for individual birds, such as reduced body mass, and can lead to lower annual survival rates of individuals at disturbed sites (Gibson et al. 2018; Rogers et al. 2006). When extrinsic factors, such as disturbance, are experienced by shorebirds during the non-breeding season, their ability to reproduce during the breeding season can be influenced (Weithman et al. 2017).

Indirect biological effects of shellfishing (Literature review continued)

The direct physical, chemical, and biological impacts of commercial non-mechanized and mechanized harvesting described previously—such as abrasion of sediments and removal, injury and disturbance of organisms—can lead to a complex cascade of indirect biological effects that may be adverse, neutral, or beneficial, depending on the species or ecological function considered. This section focuses on potential indirect biological impacts most relevant to the purposes for which the refuge was established.

Turbidity, sedimentation, and alteration of vertical structure caused by shellfish harvesting could render areas less hospitable for some benthic organisms including shellfish, crustaceans and other invertebrates, and bottom-dwelling fishes. For example, Kaiser et al. (2001) found that, over the short-term, hand raking for the cockle (a European bivalve) increased damage rates to small cockles and adversely affected the benthic community. Communities recovered within a year, and the authors noted that recovery rates are highly variable depending on the sediment type and harvest practices evaluated. Logan (2005) found that the abundance of an amphipod (a type of benthic invertebrate) was lower in plots subjected to clam digging than in undisturbed plots. However, shellfishing studies have not always identified significant biological effects. Goldberg et al. (2012) did not find appreciable short-term differences in the benthic community between hard clam beds subject to hydraulic dredging vs. untreated control plots.

Predators may be adversely or positively affected by shellfishing depending on the prey species, harvest methods, and timescale considered. Shellfishing activities that disturb the sediment and injure or expose benthic organisms in the short-term may increase efficiency of predators such as fish that prey on benthic invertebrates (Mercaldo-Allen and Goldberg 2011). Turbidity, on the other hand, may impair hunting efficiency of predators in addition to impeding respiration (Wilber & Clarke 2001). If collective physical, chemical, and biological effects were significant enough to alter plant and prey populations over a wide area over the long term, herbivore and predator populations and dynamics could be expected to be affected as well. Affected species could include waterfowl that feed on aquatic vegetation or shellfish, fish-eating waterbirds, sea turtles, and predatory fish. All of these changes might result in reduced biodiversity, altered community structure, and other ecosystem effects (Alves et al. 2003).

Considering ecosystem-level impacts, shellfish dredging has been shown to cause changes in biodiversity, species composition, feeding habitats, and community structure (Goss-Custard et al. 2004; Gravestock and Pengelly 2016). Reductions in heterogeneity of species over large spatial and temporal scales have negative consequences for diversity and stability at the population, community, and ecosystem scales (Leitão et al. 2009; Sewell et al. 2007).

3.3 Analysis of Biological Impacts within the Refuge

To interpret potential direct and indirect effects of aquaculture and shellfish harvesting in the refuge, it is important to consider the historical context and other conditions that may affect ecosystems. These include the historical presence and gradual loss of shellfish resources; numerous impacts to the Oyster Bay watershed from development and commercial shellfishing; water quality concerns such as elevated levels of bacteria and nutrients; the extent of allowable commercial shellfishing; and the Town's planned aquaculture program to restore shellfish populations and reverse some of the accumulated adverse impacts to the bay.

Target species

The direct effect on shellfish populations from aquaculture and commercial harvesting will influence population numbers and distribution. The seeding of clams and oysters through enhancement activities will increase shellfish density within placement areas and influence populations outside of these areas as the shellfish spawn and larvae are dispersed. If the Town undertakes soft shell clam restoration, it is expected to have similar effects. In 2025, the Town acquired 8,477,000 shellfish to grow out and distribute into the estuary. This included 5,133,000 oysters and 3,343,800 clams. The Town has identified the MMAs and SSAs based on suitable habitat characteristics including substrate type to offer optimal habitats for settlement and successful recruitment. The Town has indicated it intends to seed 20 million oyster and clam larvae per year (combined), if sources are sufficient, with seeding rates rising over time.

Commercial harvesting of shellfish can be expected to reduce populations of shellfish introduced by aquaculture, although this may also open up new areas where shellfish larvae can settle, as described in Mercaldo-Allen and Goldberg (2011). Recent shellfish harvesting data may inform what future harvesting could look like. Using monthly data from 2024, we estimate that, over the 2024 calendar year, commercial non-mechanical harvesters removed approximately 1.7 million individual hard clams and 3,816 individual oysters from Oyster Bay and Cold Spring Harbor harvest units; the refuge is located within these units of the estuary. Although harvest data do not directly distinguish between mechanical and non-mechanical commercial harvests, we were able to make inferences on the magnitude of non-mechanical harvest because mechanical harvest leases lapsed in September 2024. FWS is not aware of soft shell clam harvesting occurring within the refuge but cannot exclude that possibility. Soft shell clam harvest in Town waters is low in comparison to hard clams. Fewer than 50 bushels have been reported annually for Town waters between 2020 and 2022. Harvest in 2023 was reported as 116 bushels and in 2024 was reported as 286 bushels. While these estimates have considerable uncertainty, they nonetheless suggest the potential for harvesting to reduce shellfish populations within the refuge. Shellfish sanctuaries and other measures can reduce adverse impacts to shellfish.

Impacts to shellfish populations from aquaculture and commercial shellfishing may be both short-term and long-term. In the short term, these activities collectively are expected to result in an immediate increase in shellfish populations. Over the long term, successful restoration coupled with managed shellfishing should result in an even larger magnitude of increase in clam and oyster populations within the estuary that are more self-sustaining and less reliant on seeding and planting operations. Benefits would be enhanced by a sustained commitment by the Town to restoration coupled with other measures to protect estuary water quality from sources such as runoff of nutrients and contaminants.

Non-target species

Previous sections have discussed the impacts, generally positive, of restoring shellfish populations through aquaculture on other invertebrates, fish, sea turtles, and birds. They also have described potential injury, disturbance, and other effects of commercial shellfishing on these organisms. Applying these findings to the refuge, species of particular concern include fish, horseshoe crabs, and migratory birds. Oyster Bay and Cold Spring Harbor are identified as EFH for several species including demersal fish: juvenile and adult summer flounder (*Paralichthys dentatus*), winter skate (*Leucoraja ocellata*), little skate (*Leucoraja erinacea*) and all life stages of windowpane flounder (*Scophthalmus aquosus*) and winter flounder. These species, especially during the juvenile stages, can be impacted by raking and dredging. With persistent, widespread, or long-term dredge activity, this may result in lower densities of adults in these species. Placement of shells and planting of shellfish also has the potential to harm demersal fish eggs if placement occurs when eggs are present; the Town has confirmed that substrate is not placed for aquaculture purposes during this life stage for flounder (from January 15 to May 31). On the other hand, aquaculture that successfully restores shellfish populations can be expected to benefit many fish. Overall, FWS anticipates a net benefit to fish populations from the restoration program that entails measures to protect sensitive fish life stages and allows for non-mechanical, sustainable shellfish harvesting.

As noted previously, horseshoe crabs feed on marine invertebrates and themselves serve as food (in the form of eggs and larvae) for shorebirds and other organisms such as sea turtles. Horseshoe crabs may benefit from ecological restoration of the estuary, and FWS is not aware of information that would indicate that non-mechanical shellfishing has significant impacts on horseshoe crabs. However, they may be vulnerable to mechanical harvesting practices, if those practices were resumed. The Town restricts the take, injury, or destruction of any horseshoe crab between May 15 and July 15 (Town of Oyster Bay Code §196-39), but spawning can occur after this period, into September. Furthermore, outside of the spawning season juvenile crabs remain in near-shore environments, which may overlap with hydraulic dredging operations.

The refuge was established specifically as a sanctuary for migratory birds, so effects of aquaculture and commercial shellfishing on migratory birds are of particular interest to FWS. Potential effects include both direct disturbance and indirect effects through the foods on which the birds feed. Regarding disturbance, as context, substantial commercial and recreational boat traffic and other water activities unrelated to shellfishing occur within the estuary and refuge. We have previously estimated that on peak weekends, approximately 3,000 recreational boats use the refuge (USFWS 2006). Given the magnitude of existing activities, it is anticipated that aquaculture and non-mechanical commercial shellfishing would provide only a minor level of additional impacts. Aquaculture-related boating will occur only occasionally, and the non-motorized boats employed in commercial shellfishing are not expected to be highly disturbing.

Indirect effects on birds could be more substantial. Birds of concern include waterfowl (ducks, geese, and swans), gulls and terns, cormorants, loons, and raptors (osprey and bald eagle). The diets of waterfowl on the refuge are diverse, with some specializing on shellfish (e.g., scoters), others on fish (e.g., mergansers), while still others prefer vegetation (e.g., wigeon). Terns, raptors, cormorants, loons, and (to a lesser degree) gulls consume primarily fish. All of these species could benefit from shellfish restoration resulting from aquaculture due to the cascading of largely positive impacts of shellfish populations on other invertebrates, fish, and aquatic vegetation. If excessive shellfish harvesting interrupted this cascade, birds would not reap these benefits to the same degree.

Shorebirds have not been detected breeding on adjacent lands in recent decades (Sophia Brown, "Personal Communication on NYDEC Annual Piping Plover Nesting Data," August 20, 2025, Email), though moderate numbers of shorebirds may migrate through in the spring and fall. As with most impacts, the magnitude of disturbance can be expected to depend on the number of harvesters, the length of time they spend harvesting, and their proximity to shorebird habitat. Observations at Monomoy National Wildlife Refuge in Chatham, Massachusetts, indicated that clam harvesters posed less of a disturbance to shorebirds than others using the area; furthermore, shorebirds appeared to be attracted to areas where shellfish harvesting had recently occurred, potentially due to increased feeding opportunities on otherwise buried prey items (Koch 2010; Leavitt et al. 2010). (Note that these observations apply to harvesting of soft shell clams, a species typically buried deeper than hard clams). Current shellfishing disturbance is likely negligible given the low numbers of shellfish harvested but should be monitored if shellfishing and shorebird numbers increase in the future. We do not anticipate disturbance to shorebirds from commercial oyster and hard clam harvesting because it does not occur on the mudflats where shorebirds rest and feed.

Considering overall biodiversity of the estuary, Cerrato and Holt (2008) found that invertebrate species assemblages present in the sediment were opportunists and associated with recent disturbance, and Oyster Bay had low species richness compared to analogous areas. These findings point to the need to carefully manage and monitor aquaculture and shellfishing on the refuge.

As in the case of impacts to target shellfish populations, impacts to non-target species may be both short-term and long-term. Direct impacts such as injury of biota and disturbance of behavior during shellfishing operations are short-term in nature. Aquaculture may have short-term positive impacts via improved water quality, enhanced vertical structure that serves as habitat for other organisms, and increased prey availability for consumers of shellfish. Long-term increases in shellfish populations in the estuary, as intended by the Town's restoration program, could have a cascade of beneficial effects through improved physical habitat, enhanced water quality, and stable or increasing populations of fish and wildlife that benefit from healthy shellfish populations.

4. Summary of Resource Effects

Considering the collective physical, chemical, and biological impacts of aquaculture and non-mechanical commercial harvesting, restoration of shellfish populations in the refuge has the potential to provide net short-term and long-term benefits for many species of fish and wildlife that occur within the refuge and adjacent habitats. Restoration of shellfish populations and their viability through aquaculture practices can lead to structural and functional benefits to overall ecosystem dynamics and ecological integrity (Ayvazian et al. 2020; 2022; Dumbauld et al. 2009). Carefully managed harvest using non-mechanized tools targeting areas of high-density clams while adhering to Town regulations is unlikely to have lasting negative impacts on Oyster Bay resources given the dynamic tides and currents that regularly impact the sediment and the adaptations of marine organisms to this dynamic environment. However, if harvest effort, amount, or frequency increases detrimental impacts to the system or surpasses a sustainable harvest yield maintained by aquaculture activities, adjustments will need to be made to ensure the use remains compatible. Therefore, FWS will coordinate with the Town and other appropriate partner organizations on the implementation of a monitoring program that can inform assessment of impacts to wildlife and ecosystems from the aquaculture program and commercial shellfishing. This monitoring and assessment will facilitate the informed implementation of an adaptive management program for compatible aquaculture and commercial shellfishing on the refuge.

The Town's Code does not currently allow hydraulic dredging for shellfish in the estuary. This kind of mechanical shellfishing appears to result in fundamentally more severe impacts than recreational or non-mechanical shellfishing via physical transformation of the substrate (Mercaldo-Allen and Goldberg 2011, Dernie et al. 2003), increased turbidity and sedimentation (Mercaldo-Allen and Goldberg 2011), greater shellfish removal rates (Lenihan and Peterson 1998), increased injury to and bycatch of nontarget organisms (Mercaldo-Allen and Goldberg 2011), and indirect effects to fish, birds, and other wildlife due to reduced prey availability (Goss-Custard et al. 2004; Gravestock and Pengelly 2016). In alignment with Town Code and best professional judgment concerning likely impacts of mechanical harvest methods, the stipulations in this CD do not allow for mechanical shellfishing.

5. Other Visitors and Users

The refuge would remain open to priority public uses including wildlife observation, interpretation, recreational fishing, and wildlife photography. Aquaculture and commercial non-mechanized shellfishing may occur within areas of the refuge where these priority uses occur, but FWS does not anticipate significant conflict between user groups. If conflicts arise among user groups, mitigation efforts can be implemented, such as segregating users across space and time, to ensure that the proposed action will not have significant impacts to other user groups. Priority public uses occurring on the refuge will take priority and precedence over commercial uses if any specific conflicts arise or if conditions dictate segregation or mitigation measure implementation.

Public Review and Comment

The draft CD was made available for public review and comment for 30 days from April 20, 2026. The public was made aware of this comment opportunity through the refuge website, refuge social media, the refuge visitor center, and letters to potentially interested parties and elected officials. The State, area Tribes, and Town were asked to review and comment on the draft compatibility determination. A hard copy of this document was posted at the refuge headquarters located at 340 Smith Road, Shirley, NY 11967. The final CD will be available electronically on the refuge website https://www.fws.gov/refuge/congressman-lester-wolff-oyster-bay. Please contact the Refuge Manager if you need the documents in an alternative format. Three comments were received regarding commercial shellfishing and aquaculture, and FWS' response to comments is attached in the final environmental assessment.

Determination

Is the use compatible?

Yes

Stipulations Necessary to Ensure Compatibility

1. Administering an aquaculture program that achieves and sustains restoration and harvest offset objectives is necessary for commercial shellfishing as an economic use to remain compatible because the outcomes of the combined aquaculture and commercial shellfishing program must contribute to the achievement of the purposes of the refuge or the Refuge System mission.

2. Aquaculture and commercial shellfishing shall align with and adhere to all applicable Town of Oyster Bay, State of New York, and federal regulations, permitting, and licensure. The Town is responsible for enforcing Town regulations and will report to the refuge on compliance with regulations by harvesters. These requirements include:
    - Commercial harvesters and aquaculture practitioners will obtain all necessary, or applicable, Federal, Town and State permits. The Town will obtain all necessary, or applicable, federal and state permits for substrate placement in connection with its aquaculture program.
    - Method of harvest is restricted to non-mechanical techniques, without the use of vessels under motorized power at time of harvesting, in alignment with § 152-4 of the Town of Oyster Bay's Town Code.
    - The use of mechanical or powered methods and artificial methods,

including hydraulic or suction dredging, is prohibited and aligns with the Town of Oyster Bay.
    - Non-target species or undersized shellfish captured during shellfishing must be returned to the water immediately.
    - Commercial shellfish permit holders operating within the refuge will report on refuge harvest information to the Town of Oyster Bay, the State of New York and FWS.
    - Commercial soft shell clam harvesting may only take place, per current Town Code, in areas that have been specifically designated as harvestable by the Commissioner of the Department of Environmental Resources of the Town of Oyster Bay and only occur, per current Town Code, between the months of September and May, inclusive.

3. Although not anticipated and not appropriate habitat for commercial soft shell harvesting, shellfishing and digging shall not occur in vegetated salt marsh habitats, which are sensitive to digging, disturbance, and harvest effort impacts.

4. Commercial harvesting of mussels and scallops is prohibited on the refuge until or unless the FWS and the Town determine that population numbers have recovered to an adequate level to support a commercial harvest program, sufficient restoration effort has been successfully implemented, and population and habitat impacts of commercial harvest can be adequately mitigated or offset.

5. The Town of Oyster Bay will continue its Town-led sanctuary program with areas within the refuge that prohibit harvesting and will also perform restoration activities that may include, but are not limited to, shellfish seeding and placement of substrates (such as oyster shells). These areas and practices will protect spawner populations and facilitate increased shellfish populations within the estuary leading to overall population restoration and offsetting harvest impacts.

6. The Town of Oyster Bay will implement its plan for shellfish population monitoring. Monitoring throughout the refuge using plot-based methodology to determine population metrics (including total population estimates, frequency, density, and abundance), as well as substrate and sediment monitoring, will be conducted at least once every three years to allow for understanding population trends and management implications. The Town of Oyster Bay and FWS will evaluate shellfish population and substrate monitoring results and coordinate on an annual basis to assess the use and the direct and indirect impacts of this use, and to evaluate impacts to inform adaptive management refinements to aquaculture and commercial shellfishing.

If monitoring, evaluation, or observations indicate persistent negative trends, spatially or temporarily, for shellfish populations or negative impacts on wildlife, habitat, or environmental health, the Refuge Manager in close coordination with the Town, can modify the use to assist in adaptively managing the program to ensure compatibility. These modifications may include, but are not limited to, reducing allowable harvest volumes, adjusting number of permits issued, limitations on access to, or use of, specific locations during specified times, designating increases in sanctuary areas or restoration activities, or reductions in or discontinuation of the use.

7. To avoid the introduction of disease or invasive species, only clams and oysters that have been sourced from the Cornell Cooperative Extension or other NYDEC-approved sources may be dispersed on the refuge. Likewise, any substrates placed on the refuge for aquaculture and restoration purposes shall follow appropriate sourcing, quarantine, and decontamination procedures as indicated by NYDEC.

8. In coordination with the Town and through NOAA Fisheries Essential Fish Habitat consultation, in order to protect winter flounder eggs and larvae, the placement of shells or other substrate for the purposes of aquaculture will be avoided from January 15 to May 31.

Justification

In accordance with its policies, the literature cited above, and the professional judgment of the Refuge Manager, FWS concludes that non-mechanical commercial shellfish harvest combined with shellfish aquaculture, with the stipulations above, is compatible with the purposes for which the refuge was established and the mission of the Refuge System. Shellfish aquaculture activities have many short- and long-term benefits to the ecosystem. These effects collectively would result in a host of direct and indirect benefits for fish, wildlife, and plants, along with ensuring a more sustainable shellfishing program for the refuge and the Town of Oyster Bay. The benefits of restored shellfish populations include serving as habitat, foraging grounds, and food for invertebrates, fish, and birds; improving water quality and clarity through filtering; controlling harmful algal blooms; facilitating the growth of SAV; and protecting shorelines from storms, further supporting the growth of tidal marsh and SAV. The restorative impacts realized through aquaculture are largely made possible through the link with commercial shellfishing by the Town of Oyster Bay engaging in these combined reserved rights. The important and significant contributions of aquaculture-based restoration to the refuge are anticipated to sustain the commercial shellfishing harvest, achieve refuge restoration goals that would otherwise not be possible, and contribute to the ecological health and integrity of the refuge. Without the commercial shellfishing component of this overall combined program, the amount of aquaculture restoration and resulting benefits would be less, ultimately leading to lower ecological and population health than if these combined uses are not occurring on the refuge. The aquaculture and associated commercial shellfishing program, as proposed by the Town, will be closely monitored and managed so that when done in accordance with State laws and regulations, CD stipulations, and permit conditions, it will contribute to the achievement of the refuge purposes and the Refuge System mission.

Signature of Determination

SHAUN ZIEGLER

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Refuge Manager, signature and date

Signature of Concurrence

STACEY LOWE

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Date: 2026.06.15 08:39:20 -04'00'

Refuge Chief, Northeast Region, signature and date

Mandatory Reevaluation Date

2036

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