Whole Foods Market
Quality Standards for Farmed Seafood
Bivalve Molluscs

January 1, 2015

VERSION 2.0

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Introduction

Whole Foods Market is pleased to present our Quality Standards for Farmed Bivalve Molluscs. These standards are for all producers supplying or seeking to supply farmed bivalves to Whole Foods Market. These farm standards apply to producers operating worldwide and cover all methods of production. In cases where the standards vary depending on the type of production system, we have indicated this in the standard.

These standards are farm-level, meaning they specify our minimum requirements and expectations for production on the farm. Hatcheries and processing plants are not covered under these standards. Still, supplier partners are expected to maintain the highest standards for quality and food safety of seafood products. However, this will not be verified through the Quality Standards audit process. Suppliers should continue to obtain any relevant certifications such as HAACP and BRC to verify health and safety conditions at processing plants. We also expect that all local, state, and federal requirements for packing dates/shelf life, transport, and temperature controls will be followed.

In addition, these standards are designed for *individual* farms that sell farmed bivalve molluscs to Whole Foods Market and therefore should be feasible for an *individual* producer to meet. Group certification may be an option for some suppliers. Producers interested in becoming certified as a group should review the general overview guidelines for group certification in Appendix C and then inquire directly with the Certification Body to receive a more detailed guide and determine if they meet the necessary criteria for group certification.

While these standards are formal and require mandatory compliance from producers, this is a living document. As new information, farming techniques, and technology become available, we will update our standards to reflect opportunities for improvement and will work with producers to assist in the ability to meet these requirements.

Why have quality standards for farmed molluscs?

Mollusc aquaculture is commonly regarded as an environmentally friendly source of food production given the benefits provided by mollusc species and farming practices that often have a low environmental impact. As filter feeding animals, molluscs can improve water quality by filtering particles from the water column. Molluscs can help remove excess nutrients that cause eutrophication in coastal water bodies. In addition, their suspension feeding can improve water *clarity*, especially where light is limited. This in turn, promotes healthy eelgrass and other aquatic vegetation that provide habitat for fish and other species. And because once bivalve molluscs are placed on the farm for grow-out, they are not fed by the farmer. This means there is no need for concern about the impacts of feed production on forage fish populations, or of uneaten feed accumulating on the sea bottom with this form of aquaculture.

Still, environmental impacts can occur with mollusc aquaculture, the two main concerns being: 1) at high enough densities of animals on a farm or of farms in an area, animal wastes from the grow-out animals can lead to benthic organic enrichment and oxygen depletion; and 2) molluscs can deplete food resources, such as phytoplankton, upon which other species, including wild filter-feeder populations, rely. Both of these issues may lead to changes in biodiversity in the area and competition for space or other resources. Also, consumers seeking natural foods may be interested in environmentally friendly farm practices or have concerns about contamination given that molluscs are sometimes eaten raw. In response, the present standards set strict requirements for farmed mollusc production to meet consumer expectations for both responsibly farmed and healthy molluscs.

Whole Foods Market "Responsibly Farmed" Logo

The Whole Foods Market® "Responsibly Farmed" logo helps customers recognize our commitment to offering farmed seafood that has been third-party verified to meet our Quality Standards for Farmed Seafood. Suppliers interested in using this logo must receive permission from Whole Foods Market and follow our style guidelines. These logo guidelines are for both product packaging and for in-store use. Only products that meet the Quality Standards for Farmed Seafood and have been third-party verified by our approved Certification Body can display the logo. For information about the logo, including logo guidelines, please contact David Pilat. david.pilat@wholefoods.com.

Terminology:

"Must:" Required action on part of producer

"*Producer Guidance*:" Additional information provided to further define terms used in the standards or to suggest possible approaches for achieving the standards

"*Shellfish*:" Although farmed bivalves are commonly referred to as "*shellfish*," there are many shellfish species that are not included within these standards, including species of crabs and shrimp. To avoid confusion, we refer to the species covered in this document as "molluscs."

"*Should*:" Practice that is highly recommended

Scope of the Standards:

These standards apply to species within the following bivalve mollusc groups: Clams, oysters, scallops and mussels. Geoducks and abalone are *not* covered under these standards.

Definition of "Aquaculture" for Farmed Bivalve Molluscs:

With bivalve molluscs, there is some variability in how aquaculture is defined and more specifically, how aquaculture is differentiated from wild-capture fisheries. For the purposes of the current standards, this issue is important because Whole Foods Market suppliers must distinguish whether their production system falls under the Whole Foods Market Quality Standards for Farmed Seafood and the related program requirements, or if it should be evaluated as a wild-capture fishery. Some international organizations offer definitions. For example, the Food and Agricultural Organization of the United Nations (FAO) defines aquaculture as follows: "*The farming of aquatic organisms involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated*." Some researchers also point out that aquaculture and wild-capture fisheries are in some cases completely independent of one another, while in other cases, they exist along a continuum where aquaculture and fisheries intersect.

For the purposes of the current standards, we define mollusc aquaculture as follows:
The farming of aquatic organisms whereby growers *enhance* production by *maintaining* and *managing* cultured stocks in a defined area. In addition, to qualify as a farmed product (i.e., not wild-caught), ALL of the following conditions must be met:

- Producers regularly add seed to the farm. Seed may originate from a hatchery or be collected from the wild. Understanding that natural sets of seed can occur, the hatchery seed may be complemented by natural sets. AND;
- Producers have control of—either through ownership or leases—the area where they are farming. Harvesting molluscs in areas open to the public does *not* qualify as aquaculture and should be considered a wild-capture fishery. AND;
- Molluscs do not have to receive any added feed to be considered "farmed."

Producer guidance:

- Farmed molluscs may be grown on-bottom, in bags, or off-bottom suspended on ropes, rafts, racks, longlines, or other infrastructure, and still fall within the scope of these standards.

Statement on Feed:
Although mollusc seed raised in hatcheries receives algae as feed, once bivalve molluscs leave the hatchery (or for the duration of their lives if seed is sourced from the wild), diets are entirely comprised of wild organisms, such as phytoplankton and detritus that bivalve molluscs filter from the water column. No feed is added to the grow-out state of cultivation. Therefore, these standards do not include requirements for feed.

Statement on Harvesting:
Bottom culture of molluscs, such as oysters, creates a complex benthic environment. Considered ecosystem engineers, the shells create 3-dimensional structure in a sedimentary environment. This additional structure creates habitat for other organisms, and the oyster 'reef' is known as a hotspot for biodiversity. In addition, oysters clean the seawater through their filtration, providing greater sunlight to aquatic vegetation. Farming of oysters provides a variety of ecosystem services, much like natural oyster populations.

Harvesting techniques that involve small, toothed dredges remove oysters as well as disturb other benthic fauna. In some sub-tidal environments, this harvest method is necessary in order to have access to oysters in water too deep to harvest by-hand. Although there have been some concerns about dredging farmed molluscs, there are also a number of factors which suggest that use of small dredges traditionally used for harvesting farmed molluscs can be a responsible form of production. First, the oyster grounds that have been in cultivation for many years continue to thrive as oyster habitat, which indicates that the environment remains viable. Second, because oysters take several years to grow, dredging is infrequent at any single location. Following harvest, farmers re-plant the area with juvenile oysters on shell material (cultch); the survival and growth of the juveniles is evidence that habitat conditions are suitable for molluscs. With dredging there is mortality of associated animals such as worms and crustaceans, but studies have shown that their numbers return in the course of a year. As the new reef assemblage grows, the services provided by this community are restored.

Summary Table of Key Metrics

NOTE: Not all standards, or all details of standards, are included in the table below. Please review entire standards document.

Reference Number	Metric
1.1	Compliance with all local, state, and national regulations; reporting of any violations
1.2	Completion and regular updating of Operator Profile
1.3	Annual auditing by independent Certification Body selected by Whole Foods Market
1.4	Maintenance of records to document compliance with standards
1.5	Initial and ongoing employee training on present standards conducted by producer
2.1	No genetically modified or cloned molluscs permitted
2.2	Raise native species unless established over several decades
2.3	Documented action steps to prevent spread of pathogens when sourcing seed
2.4	Triploids permitted; acceptable methods detailed in standard
3.1	No synthetic pesticides permitted
3.2	No copper-based antifouling agents or other toxic antifoulants permitted
4.1	No harvesting from public areas that are not subject to ownership/rights by the producer
4.2	Maps of farm locations required, with evaluation and assessment of risks of potential contamination
4.3	Farms subject to rigorous water quality monitoring program; acceptable water quality classifications listed in standard
4.4	Additional testing requirements for environmental contaminants for any farm located in restricted waters and depurating
5.1	Farms participate in benthic monitoring program specified in standard; achievement of scores in “Healthiest” or “Moderate” categories
6.2	Maintain or enhance sensitive habitats (e.g. SAV; oyster reefs)
6.3	Written plan for, and proper disposal of, farming gear and materials. Discarding gear in coastal environment prohibited
6.4	Utilize shell material productively (e.g. for restoration, as oyster cultch, etc.)
6.5	Detail steps to prevent spread of invasive species
7.1	Physical exclusion of wildlife predators or other non-lethal methods must be first level of defense
7.2	No exclusion nets on longline gear permitted
7.3-7.4	Last resort lethal predator control methods must not cause wildlife to suffer and must target the offending animal only
7.5	No lead shot permitted
7.6	No intentional killing of predators listed as vulnerable, endangered, or critically endangered permitted.
7.8	No Acoustic Harassment Devices (AHDs) permitted until research adequately assesses impacts to marine life

7.9	Incidental killing of predators must be reported to Whole Foods Market
8.1	Recall program in place; tested annually
8.2	Tag to maintain identification of producer and harvest area throughout the supply chain
8.3	Proper labeling of product as “farm-raised”

1.0 General Requirements:

1.1 Compliance with Government Regulations

Producers must comply with all local, state, and national laws, codes and regulations governing operations, including, but not limited to those categories listed below. Producers must inform Whole Foods Market of any major violations to government laws and regulations and specify corrective actions that will be taken.

- Health and safety
- Labor and employment
- Production siting and zoning
- License and leasing requirements
- Environmental regulations
- Water quality
- Movement of animals to prevent introduction of exotic species
- Movement of animals to prevent disease
- In the United States, National Shellfish Sanitation Program (NSSP) and HACCP requirements.
- Endangered/threatened species that use same habitat as farm

1.2 Operator Profile

Each producer must complete an Operator Profile (OP), which identifies practices implemented to ensure compliance with all applicable sections of Whole Foods Market Quality Standards for Farmed Bivalve Mollusc. The OP must meet the following requirements:

- An updated version must be submitted annually to the Certification Body (CB), at least 1 month prior to the audit.
- It must be current at all times. If there are any changes in production practices, producers must update the document and re-submit to the CB within one month.
- It must reflect actual practices on the farm.
- It must include maps that detail farm location and layout of sites.

Farms that have written Standard Operating Procedures (SOPs) or a Quality Manual can provide a copy with their OP and refer to the relevant section within the OP.

1.3 Audits

All documentation, records, and production units are subject to an annual audit by an independent Certification Body (CB), selected by Whole Foods Market. These third-party audits must be paid for by suppliers.

Producer guidance:

- Producers are reminded that it's their responsibility to learn and understand the standards and comply with all components of the program. Producers should proactively reach out to Whole Foods Market with any questions about the standards and work continuously to implement the standards on their farms, including any necessary corrective actions. The role of the CB is to verify compliance and issue certifications to qualified producers, rather than to serve as a trainer for the standards.

1.4 Records

Each farm must maintain and provide the auditor full access to records sufficient to document compliance with all applicable Whole Foods Market Quality Standards for Farmed Seafood. Records must be signed by farm owners as accurate. Inaccurate reporting could lead to suspension of business with Whole Foods Market. Records may be held in a range of formats, including computer programs, hard copy files, but must be accessible during audits. The records requested will include the following:

1.4.1 Farm Stock Information for molluscs sold to Whole Foods Market

- Source of any mollusc seed or larvae brought onto the farm for grow-out.
- Name of lease holder (or other name that identifies the lease) and number of bed(s) or off-bottom leases from which molluscs are harvested.
- Location of beds/leases (with GPS coordinates) from which molluscs sold to Whole Foods Market are harvested.

1.4.2 Health—Molluscan and Human Pathogens

- Records of health checks conducted on the farm
- Data on incidences of disease or parasite outbreaks

1.4.3 Predator Interactions

- Records of any intentional or incidental killing of protected marine mammal or bird species, such as sea ducks. For killing of bird predators on farms in the United States, a copy of the annual report to the U.S. Fish and Wildlife Service is sufficient.
- Description of any lethal control methods used to control protected predator species, with details on what non-lethal methods were tried and why they failed.

1.4.4. Benthic Monitoring

- Archived copies of data derived from annual monitoring program (will be used to track changes in conditions/impacts over the years), including:
    - Date of sampling
    - Number of samples collected
    - Results of Level 1 Scoring, including photographs
    - Results of Level 2 Categories, if applicable
    - GPS coordinates of all sample locations
    - Water depth of all sample locations
    - Record of any changes in lease/farming area dimensions or locations
    - Records of any changes in maximum stocking density above sampling sites
    - Documentation of any problems with husbandry that affected the bottom and benthic monitoring results (falloff, mortality)

    - Notes of any changes in the local area relevant to marine impacts (e.g. dredging)

1.5 Employee Training
Initial and ongoing training on the present standards must be provided by the producers to all farm employees. It's the responsibility of the producers to ensure that the requirements of these standards are understood by all individuals handling products sold to Whole Foods Market.

Producer guidance:

- Training should provide an overview of the entire operation as well as specific training related to the tasks that will be required.
- Training can be experience-based or through a formal program.
- Training should provide information on the specific requirements of the Whole Foods Market standards for all responsible staff.

2.0 Source of Grow-out stock

2.1
The use of genetically modified or cloned molluscs is prohibited.

Producer guidance:

- *Genetically modified* is a term that describes the products of the use of gene splicing, recombinant DNA technology, transgenic technology or other manipulation of genetic material ***outside of the practices*** of traditional breeding, conjugation, fermentation, hybridization, in vitro fertilization or tissue culture.
- *Cloning* is defined as the use of technology to create an exact genetic copy of another organism. Both cloned molluscs and their progeny are prohibited under this standard.

2.2
To protect genetic diversity of native mollusc populations and prevent the spread of disease, producers should prioritize raising species native to the area where they're grown, rather than introducing exotic species to a new area. If a producer aims to introduce an exotic species to a new area, or aims to continue raising a non-native species that is not well established, they will be evaluated on a case-by-case basis prior to audit to determine if it's acceptable for Whole Foods Market. Whole Foods Market will review whether ICES Code of Practice on the Introductions and Transfers of Marine Organisms has been followed as well as any local, state, or regional requirements. Exotic species that have already been introduced and have been established for several decades, such as C. *gigas* in the U.S. Pacific Northwest, are acceptable under these standards.

Producer guidance:

- "Exotic" species, also known as "introduced," are species not native to the area where they are raised. FAO defines introduced species as "Species (including associated races or strains) that are intentionally or accidentally transported and released by humans into an environment outside their natural range."

- Mollusc aquaculture is a major source of marine invasive species. Impacts of non-native species include introductions of diseases and competition. For example, introduced non-native species may establish breeding populations that affect resident native species, especially if the non-native species grow faster. Pacific oyster species, for example, have been shown to out-compete native oysters in France, Australia, New Zealand, and the west coast of the U.S.
- Examples of well-established non-native species are the Manila clam (*Venerupis philippinarum)* and the Pacific oyster, *C. gigas.*

2.3.
To prevent the spread of pathogens to growing areas and surrounding waters, producers must document the specific action steps taken when sourcing hatchery-raised seed.

Producer guidance:

- An example of robust disease prevention is the program in the U.S. state of Washington, which requires that seed from hatcheries out-of-state has a Shellfish Import Permit and seed from in state has a Shellfish Transfer Permit from the Washington Department of Fish and Wildlife. Both permit types require that hatchery seed is approved as "disease free" by the registered pathologists. http://apps.leg.wa.gov/wac/default.aspx?cite=220-77-040.

2.4
Raising triploid molluscs is permitted using the methods described below. Any other methods used to create triploids must be reviewed by Whole Foods Market for acceptance under the current standards.

Producer guidance:

- Triploid oysters are known as sterile or "spawnless" oysters that are preferred by some producers and seafood buyers for their texture and growth, particularly during summer months when natural oysters typically spawn.
- Inducing triploidy entails retaining a set of chromosomes, which hinders the animal from producing gametes (eggs and sperm).
- Triploids are created by one of two methods today, both of which are permitted under these standards: 1) applying a temperature shock to the grow-out oyster; and 2) creating a tetraploid male "parent" then mating it with a normal diploid female, which yields triploid offspring.

3.0 Drug and Synthetic Chemical Use

Although few drugs or synthetic chemicals are currently used or needed in mollusc aquaculture, Whole Foods Market Quality Standards for Farmed Seafood, prohibits antibiotics, preservatives, malachite green, crystal violet, Tributyltin compounds, organophosphates, and other carcinogenic pesticides.

3.1 Pesticides

Use of all synthetic pesticides, including organophosphates, and any pesticides with toxic carcinogenic, teratogenic, mutagenic, or ecological effects is prohibited on mollusc farms. Prohibited pesticides include Carbaryl due to its toxicity to arthropods.

Producer guidance:

- Teratogenic substances are those that cause developmental toxicity, such as birth defects; mutagenic substances are those that cause genetic mutation; carcinogenic substances are those that cause cancer.

3.2 Antifoulants

Due to the sensitivity of molluscs and the critical importance of good water quality for raising these filter feeding animals, fouling organisms found on bags, racks, and other gear must be cleaned *without* synthetic chemicals. Copper-based antifouling agents (e.g. paints), or other toxic antifoulant products are prohibited on farm gear. This prohibition against using toxic antifoulants on farm gear does not extend to use on boat hulls and docks, as it may be necessary to prevent transfer of invasive species.

Producer guidance:

- To control fouling organisms, producers should use methods such as air-drying, mechanical cleaning, or other non-toxic methods.

4.0. Water Quality and Environmental Contaminants

***Explanation for section*: Growers and scientists unanimously identify water quality as the single most important factor for sustainable and high quality production of farmed molluscs. The following section aims to address two major components of ensuring good water quality: siting farms responsibly and water quality monitoring.**

4.1 Control and responsibility for site

Farmed bivalve molluscs produced under these standards cannot be harvested from public areas that are not subject to ownership/rights by the grower. Producers must present the CB with permits, leases, grants, or concessions required by government that demonstrate that the producer has control and responsibility for the site.

4.2 Protection against organic and inorganic pollutants

Producers must include in their Operator Profile (Standard 2.1), and present to the Certification Body (CB), up-to-date maps showing the location of all farms and surrounding areas, with grow-out areas clearly marked. Farms must demonstrate that they have evaluated and assessed risks of potential contamination to the farm site from organic and inorganic pollutants by indicating on the maps the distance from any potential sources of contamination.

Producer guidance:

- For farms in the U.S., data from NOAA's Mussel Watch program may be used to help make this determination, if there is a monitoring site located near the farm and water flow moves in the direction that makes the data relevant. Other sources of information may include studies from the U.S. Environmental Protection Agency (EPA) or universities.

- *Background*: Whole Foods Market understands that when selecting farm sites, producers consider a suite of criteria for running a productive farm and a profitable business. Criteria include availability of food (e.g. phytoplankton and detritus), current speed, water temperature, sediment types, water quality and flow, salinity, etc. This section is not intended to dictate what producers need to do to select an ideal farm site, but rather to ensure that producers have sited farms responsibly to reduce the risk of exposing molluscs to contamination and avoid negative impacts to the surrounding environment.
- Because molluscs ingest particulate matter and are often consumed raw, consumers are at risk of contamination from bacteria and viruses. Therefore, extra precautions are needed to prevent exposure to contaminants.
- Point sources of contamination may include: sewage treatment plants, domestic septic tanks, waste water from nearby industrial or agricultural activities, etc. Non-point source contamination can include land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification and may originate from run-off from roads (oil), urban or agricultural land, other aquaculture operations, fertilizers, herbicides, construction sites, etc.

4.3 Protection against Microbial Contaminants

Whole Foods Market seeks to ensure that farmed molluscs are sourced from farms operating in waters with optimum water quality and low probability of, or absence of, pathogenic organisms. Whole Foods Market prefers to source molluscs harvested from areas classified as "remote," "approved," or "conditional" (see definitions below) under the guidelines of the Food and Drug Administration's (FDA) Interstate Shellfish Sanitation Conference (ISSC). Growing molluscs in areas classified as "restricted" is only permitted if the animals are "depurated" following the specific protocols of the U.S. Food and Drug Administration's (FDA) National Shellfish Sanitation Program (NSSP) and the additional requirements listed in Standard 4.4 below.

Farms must be subject to rigorous water quality monitoring and water quality regulations *that are enforced* to prevent molluscs from being harvested from areas with poor water quality. Since implementing a water quality monitoring program is beyond the scope of these standards, farms must be subject to a monitoring program implemented by local/regional/federal governments, such as the ISSC/NSSP in the United States. Producers raising molluscs in other countries must demonstrate that their waters have been classified according to comparable criteria to the U.S. and that they have a comparable monitoring program to the U.S. Interstate Shellfish Sanitation Conference (ISSC) and National Shellfish Sanitation Program (NSSP).

Producer guidance:

- The Interstate Shellfish Sanitation Conference (ISSC) and National Shellfish Sanitation Program (NSSP) in the U.S. and the Canadian Food Inspection Agency (CFIA) in Canada work to control the safety of shellfish by preventing their harvest from contaminated growing areas. They use fecal coliform bacteria as the primary indicator of contamination in a water body.

- At the time of publication of the present standards, producers from U.S. states, Canadian Provinces, Mexico, and New Zealand that export molluscs to the United States are enrolled in the NSSP program.
- Producers growing molluscs in other countries for Whole Foods Market stores outside of the United States should contact Whole Foods Market to assess whether the country's program qualifies as comparable to the U.S. NSSP program.

Additional requirements for depuration:

- Documentation showing that the UV reactors have undergone validation testing that determines the operating conditions under which the reactor delivers the required UV dose for treatment (see § 1.4.1 UV Dose and Validation Testing Requirements of the *US EPA Ultraviolet Disinfection Guidance Manual For The Final Long Term 2 Enhanced Surface Water Treatment Rule*)
- Documentation showing that the UV light source manufacturer's replacement schedule is being met
- Documentation showing that the UV light source manufacturer's turbidity filter is being met
- Filtered water is measured daily for total coliforms
- Flow rates are measured and documented daily
- Written procedures are in place for handling power outages (amount of time that water is not flowing is excluded from depuration time; extended outage possibly resetting the clock, etc.)
- Documentation of daily washing and sanitizing of depuration tanks
- Dissolved O_2 measurements
- Test & Hold each batch for tissue samples

Terms defined:

- Depuration: Process by which shellfish are held in tanks of clean seawater under conditions which maximize the natural filtering activity which results in expulsion of intestinal contents, which enhances separation of the expelled contaminants from the bivalves, and which prevents their recontamination (FAO 2008).
- Wet Storage: Wet storage is *not* the same as depuration. Wet storage is defined by the NSSP program as, "the storage, by a dealer, of shellstock from growing areas in the approved classification or in the open status of the conditionally approved classification in containers or floats in natural bodies of water or in tanks containing natural or synthetic seawater at any permitted land-based activity or facility."
- "Remote" status indicates that the growing area is so remote that there's no possibility of contamination and therefore less restrictive requirements are in place for monitoring under the NSSP.
- "Approved" Classification indicates that the growing area is determined by sanitary surveys to have no unacceptable concentrations of fecal material, pathogenic microorganisms, or poisonous and deleterious substances. Therefore, the NSSP does not place any limitations on harvesting shell stock from growing areas classified as "approved."

- "Conditional" (Seasonal) Classification signifies that a growing area is subject to intermittent microbiological pollution events. This classification may be applied to areas where water quality is dependent upon a water treatment plants operating effectively, or when there is are rapid or seasonal changes to water quality either due to human population fluctuations or discharge of pollutants from non-point sources.
    - Determination of classification as "conditionally approved" or "conditionally restricted" depends on whether state resources are sufficient to survey, monitor, managed, control harvesting, affect closures, and reopen areas. The potential sources of pollution must also be evaluated and performance standards must be set based on total quality of sewage, vessel traffic, amount of rainfall in the area, height of rainfall, design of waste treatment plants, etc.
    - Conditional areas are subject to a management plan that establishes strict criteria to be met in order for the growing area to be afforded "open" status.
- "Restricted" Classification signifies that the growing area is not grossly polluted, but also does not meet the "approved" area criteria. This classification may be used in instances where water quality fluctuates unpredictably or frequently due to non-point source pollution from urban or rural sources.
- "Prohibited" Classification is for areas subject to extreme pollution and exists to prevent consumption of contaminated shellfish. Harvesting shell stock from prohibited areas for human food use is not allowed. Growing areas where the shellfish authority has not conducted a sanitary survey, or immediately adjacent to a sewage treatment plant outfall are also subject to this classification.

4.4 Additional requirements for farms located in "restricted waters" and depurating:
Farms located in "restricted" waters and "depurating" to rid the animals of microbial contaminants must take additional precautions to ensure that molluscs do not have high concentrations of environmental contaminants. Farms in this category must have molluscs tested *annually* for at least the same 140 analytes (organic and trace elements) used by NOAA's National Center for Coastal Ocean Science's (NCCOS) Mussel Watch program. If a farm is located in an area known to be high in a particular contaminant, additional contaminants may need to be tested (e.g. flame retardants (PBDEs). To implement these requirements, farms must follow the sampling methodology of the Mussel Watch program and submit tissue samples to the Mussel Watch approved program laboratory. Whole Foods Market and the Certification Body will evaluate contaminant levels and compare results to current FDA action levels and EPA Guidance.

Producer guidance:
- For information on the Mussel Watch field methods: http://wdfw.wa.gov/publications/01381/. To contact the Mussel Watch program: http://ccma.nos.noaa.gov/about/coast/nsandt/musselwatch.aspx.
- Studies such as O'Connor (2002) and data from the Mussel Watch program document strong connections between chemical concentrations and density of human populations. O'Connor, T. Marine Environmental Research 53 (2002) 117–143. Therefore, farms located in urban areas, where waters are classified as "restricted" must undergo additional testing.

5.0 Benthic Impacts

5.1 Whole Foods Market recognizes that farmed bivalve molluscs provide beneficial ecosystem services. However, if excess organic loading is concentrated in a given area, impacts can occur, such as reduced oxygen content in the sediments, reduced biodiversity, and high sulfides, which are toxic to oxygen-dependent organisms. Our goal with this standard is to ensure that the farms from which we source maintain healthy benthic communities beneath and surrounding culture sites. This standard provides a method for evaluating the health of the benthos and maintaining healthy conditions under and near farms. Cost-effective monitoring of benthic impacts from aquaculture and practical implementation of the standards were the major priorities in developing this program.

This standard includes a 2 level process: first, pre-screening for all farms using a simple Visual Redox Assessment method; and second, for farms where benthic impacts are evident from pre-screening results, a more rigorous sediment geochemistry sampling and analysis program. This approach allows us to:

a) Determine which farms need to be monitored more frequently and which ones less frequently.
b) Establish baseline data with which we can compare future results.

Level 1 Pre-Screening with Visual Redox Assessment:
All producers will undergo two years (once per year) of Visual Redox Assessment. This method simply requires growers to use a clear acrylic tube to take sediment cores and provide digital photographs of the sediment cores to the Certification Body (CB). Photographs enable the Certification Body to remotely measure the depth of the Apparent Redox Potential Discontinuity (ARPD), which is an indicator of the presence of stored mineral sulfides. Color change near the sediment surface is indicative of sub-oxic conditions, especially when compared to a reference station. In addition, the Certification Body uses the photographs to look for evidence of animals in the sediment, which is an indicator of the presence of benthic fauna. **Specific instructions for taking samples and photographs are provided in Appendix A. Compliance with the methodology specified is essential.** The results are scored as follows:

Average ARPD* (cm)	**greater than 1**	**less than or equal to 1**
Score	**1**	**0**
Bioturbation (fauna present)	**Yes**	**No**
Score	**1**	**0**

Scoring Categories (sum of scores above):

	Healthiest (Oxic)	**Moderate (Sub-oxic/low O2)**	**Unacceptable (anoxic/absence of O2)**
Pre-screening Sum Scores	**2**	**1**	**0**

Scoring Implications for Pre-screening:

- After the first year, growers with an "Unacceptable" rating will be expected to provide a mitigation plan to alleviate anoxia. If a second year Visual Redox Assessment screening indicates another "Unacceptable" rating, additional mitigation steps will be expected, and the third year of testing will require Level 2 sulfide analyses.

- Growers with a "Moderate" rating in the first 2 years will be expected to undertake a third year of Level 1 Visual Redox Assessment. A consistent "Moderate" rating will allow movement to less frequent (biennial) Visual Redox Assessments. Any movement into "Unacceptable" will require a mitigation strategy and/or Level 2 sulfide analysis.

- Growers with a "Healthiest" rating during the first 2 years will move to a biennial or less frequent screening plan to be determined in consultation with WFM. Consistent performance with this approach will *not* require Level 2 sulfide analysis.

Role of third-party auditors and consultants in Benthic Sampling and Analysis:
To ensure consistency and quality, when audits occur on-site, producers will collect samples (Level 1 Pre-screening) in the presence of the Certification Body. The Certification Body will confirm that samples are collected properly, at the correct location, and that photographs adequately capture the information required in the standard. For those producers who must undertake Level 2 analysis in the future, consultants may be required.

Level 2: Sediment Biogeochemical Method—Sulfide Analysis
The Level 2 method is based on four inter-related variables: sulfide, redox potential, organic matter, and porosity. This method is only required for growers that have had "Unacceptable" results after two years of Pre-screening and have been unable to mitigate benthic impacts (see producer guidance below). However, we anticipate that few farms will undergo Level 2 Sulfide Analysis because the Pre-screening process provides growers with two years to detect and mitigate any major benthic impacts. The intention with this approach is to identify any existing problems with the low-cost Pre-screening method and implement solutions before problems are compounded.

Level 2 Categories:

Results may fall into 3 categories: Healthiest (Oxic), Moderate (Hypoxic), and Unacceptable (Anoxic). The numbers generated from these analyses are two-fold: 1) absolute values; and 2) relative differences between reference and culture sites. Comparing absolute values with values from reference sites demonstrates the range of values in the natural environment and also shows whether site samples are similar to that which is expected under natural conditions, or if they are outside of the expected range (Hargrave *et al*. 2008).

Sediment Geochemistry--Category	**Healthiest-Oxic**	**Moderate-Hypoxic**	**Unacceptable-Anoxic**
Sulfide (μM)	less than 1000	1000-3000	greater than 3000
Redox potential (mV)	greater than 100	less than 100 to -100	less than -100
Organic Matter (%)	Approximately similar to reference	1-5× reference	5-10× reference
Porosity (%)	Approximately similar to reference	1.5-2× reference	>2× reference

When analyzing sediment biogeochemistry, "sulfide concentration" is the dominant variable in determining the health category ("Healthiest," "Moderate," or "Unacceptable"). The other variables are used to confirm the sulfide category. For example, if the sulfide scoring category is "healthiest" and the other variables were found to be in the "Unacceptable" category, repeated sampling might be required.

Category Implications:

- Growers with in the "Unacceptable" category from Level 2 Sulfide Analysis in year 3 (following 2 years of Pre-screening), must undergo further mitigation and follow-up with another year of sulfide analysis (Year 4). If a second year of sulfide analysis (Year 4) shows that results are still unacceptable, farms may not be able to sell products to Whole Foods Market.

- If results from Year 3 Sulfide Analysis are in the "Moderate" Category, producers can return to using the Pre-screening method and repeat monitoring annually until they can demonstrate consistent results in the "Moderate" or "Healthiest" category. At that point, frequency of monitoring may be reduced.

- If results from Year 3 Sulfide analysis are in the "Healthiest" Category, producers can move to biennial or less frequent monitoring using the Pre-screening technique.

Producer Guidance:

Suggestions to mitigate impacts:

1. Minimize falloff of animals to the bottom in suspended culture.
2. Avoid dispersal of removed fouling material to the bottom of culture sites.
3. Consider space available for moving culture operations to create fallow areas.
4. Avoid accumulation of drift or fouling algae at intertidal sites.
5. Producers should be aware of other potential influences on organic loading including river runoff and agriculture, and make note of specifics to WFM.

- **Reference:**

Hargrave, B., M. Holmer, and C. Newcombe. 2008. Towards a classification of organic enrichment in marine sediments based on biogeochemical indicators. Mar. Poll. Bull. 56: 810-824.

6.0 Ecosystem Protection

6.1. Statement on Ecosystem Carrying Capacity

Whole Foods Market seeks to maintain natural species communities as well as support mollusc aquaculture because of the suite of environmental benefits it offers. For example, mollusc aquaculture provides ecosystem services, such as mitigation of excessive land-based nutrients that can harm coastal ecosystems. Although evaluating the capacity of *whole ecosystems* to handle the potential negative environmental impacts of mollusc aquaculture is an extremely active area of research today, it is beyond the scope of these standards, which apply to individual farms. See Appendix B for full explanation. Still, it is Whole Foods Market's goal to source from producers who are working toward accurately assessing any environmental impacts from their farms.

Producer guidance:

- Producers can be proactive by exploring tools such as the Farm Aquaculture Resource Management (FARM) software (http://www.farmscale.org/), which allows farms to estimate the appropriate shellfish density for optimal carrying capacity (i.e., the greatest sustainable yield of market-sized animals within a given time period). This type of farm evaluation tool does not set a standard for what the acceptable level of impact should be, but it can help to provide the data to move in that direction (see Appendix B for details)

6.2

Damaging sensitive habitats, such as submerged aquatic vegetation or oyster reefs is prohibited. Producers must demonstrate that they are maintaining or enhancing these sensitive habitats. Present auditor with up-to-date maps showing the location of sensitive beds of submerged aquatic vegetation in relation to their own site.

Producer guidance:

- Submerged aquatic vegetation (SAV) includes eel grass, turtle grass, and others. Seagrasses provide important habitat and have declined worldwide due to nutrient enrichment and subsequent increases in phytoplankton biomass, which can increase turbidity in water and thereby reduce light needed for seagrasses to survive.

- Oyster reefs provide critical ecosystem services. Oyster reefs are estimated to have declined 85% worldwide. As ecosystem engineers, oysters create habitat conditions that other animal and plant species in coastal bays and estuaries worldwide thrive upon. Molluscs also provide important ecosystem services such as shoreline stabilization, water filtration, and food and habitat for birds, fish, crabs, and people.

6.3 Derelict gear

Producers must have a written plan for safe and proper disposal of farming gear and materials, including plastics and metals, and demonstrate through the plan that they monitor their sites and surrounding areas for lost gear. Discarding or leaving gear as permanent waste in the coastal environment is prohibited under these standards.

Producer guidance:

- Derelict gear can trap and entangle wildlife and is unsightly in the marine environment.
- Farming gear and materials can include, but is not limited to polypropylene netting, metal wiring, chicken wire, and other types of mesh used for predator exclusion.
- Recovery of natural fiber materials that are biodegradable, such as cotton socking for mussel longlines, is not required.

6.4 Shell Disposal

Whole Foods Market prefers that farms with shells on-site (e.g. those dealing in shucked oysters) utilize shell matter productively. For example, shell may be returned to water (following local regulations) to be used for restoration or other conservation efforts, as oyster culch, or for spat collection in hatcheries. However, discharge of shell must not negatively impact Submerged Aquatic Vegetation (SAV) or other sensitive habitats.

Producer guidance:

- Mollusc shells play a valuable role in marine ecosystems and the coastal environment, including:
    - Shell accumulation provides structural habitat complexity that contributes to species diversity.
    - Mollusc stocks depend on the maintenance of a positive shell budget for carbonate and provision of habitat, which supports recruitment, growth and survival of bivalve molluscs.
    - Shell aids in erosion control.
    - Shell serves as an important source of sedimentary carbonate. It can buffer against increased acidity associated with ocean acidification, which results from atmospheric CO_2.
- Farms located in the United States are subject to permitting regulations for use of shell under the umbrella regulations of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Producers growing molluscs in other countries should contact Whole Foods Market to assess whether the country’s regulations qualify as comparable to U.S. regulations.

6.5 Invasive Species

Producers must have steps included in their Standard Operating Procedures or farm plan to prevent the spread of invasive species, such as nuisance fouling organisms. Molluscs, culture gear, and vessels should not be transported to new or different growing areas without thorough removal of and inspection for invasive species.

Producer guidance:

- An example of an invasive fouling organism includes the vase tunicate, *Ciona intestinalis,* which affects mussel farms in some areas.
- An example of techniques used to prevent the spread of invasive species includes filtering waste water from facilities used to de-foul culture gear. This precaution can help avoid reintroducing invasive organisms back into the marine environment.

Section 7.0: Predator Control

7.1

Physical exclusion of marine mammal or bird predators, or other *effective* non-lethal methods, must be the first level of defense to minimize the possibility of contributing to the decline of predator populations or negatively affecting habitat or behavior of predators. Lethal means of predator control can only be employed if non-lethal means have been ineffective. If lethal means are used, producers must describe in detail the non-lethal methods that were attempted and the reasons they failed.

Producer guidance:

- On mussel farms, sea ducks, including species of scoter and eider ducks, are likely the most common predator. Many sea duck species consume molluscs, especially mussels, as a major component of their diets. Sea ducks may benefit molluscs by feeding on fouling wild mussels that grow on longline structures or be a nuisance if ducks consume cultured stock.
- Ducks are protected species in several countries, including the U.S., Canada, and Scotland. Marine mammals are also protected species in the U.S., as well as several other countries.
- The most effective non-lethal sea duck deterrent methods are human activity on the farm and predator exclusion nets surrounding raft culture. *Other non-lethal methods may include*:
    - Mesh or other netting to cover clam beds; oyster cages, bags, etc.
    - Short-term installation of small mesh/twine exclusion nets that prevent entanglement
    - Seeding the correct size seed
    - Timing grow out when predators are less active in the area
    - Siting farms in areas where predator populations are scarce
    - Double socking mussel lines when ducks are present
- Sea duck deterrent devices that have demonstrated only variable, short-term success due to the ability of sea ducks to habituate to the sound include gas cannons, shooting blanks, fireworks, and predator vocalizations. Visual deterrents that show minimal success due to

rapid habituation by sea ducks include scaring devices, such as scarecrows, plastic owls, scary eye buoys, mirrors, reflectors, and lights.

7.2
Due to the risk of entangling sea birds and other marine life, exclusion nets are prohibited on mussel longline gear until more research is conducted to demonstrate the appropriate shape and structure.

7.3
If lethal means are used, they must not cause wildlife to suffer. Lethal means of predator control should result in immediate death.

7.4
Lethal means of predator control must target the offending animal(s) only.

7.5
Lead shot is prohibited, for both scaring and killing predators.

7.6
Intentionally killing predators listed nationally or globally as vulnerable, endangered, or critically endangered (e.g. by IUCN) is prohibited.

7.7
If lethal means of predator control are employed, population assessments for the predator species must be available to demonstrate that the population is not stressed or that culling is not contributing to decline of the population.

7.8
Acoustic Harassment Devices (AHDs) are prohibited unless producers can show that research has been conducted to assess potential impacts of the AHD on marine life. The volume and frequency of sound emitted from the AHD must not interfere with communication between other marine animals, such as marine mammals.

Producer guidance:

- Acoustic Harassment devices are also referred to as Acoustic Deterrent Devices, (ADDs), "pingers," or seal scarers.
- For the purpose of this standard, AHDs include Underwater Playback Systems (UPS) of engine noise used to scare ducks.
- This standard is included because some producers are considering using AHDs as deterrents for ducks. However, little is known about the hearing of ducks underwater.

7.9
Producers must report incidental killing of avian, terrestrial, or mammalian predators (e.g. drownings or entanglements in predator nets) to Whole Foods Market and the CB. Details on the number of deaths, injuries, and the species affected should be documented in both

the Operator Profile as well as the producer's records, which are subject to audit. Deaths of protected or endangered species must be immediately reported to Whole Foods Market.

8.0 Traceability

8.1. Tracking systems

Molluscs sold to Whole Foods Market must have a tag that maintains the identification of the producer who grew the product as well as the harvest area. If products are not sold directly to Whole Foods Market, producers must have a signed letter from all distributors, wholesalers, and wet storage facilities stating that the producer's identification is maintained on the tag throughout the supply chain.

8.2 Labeling

Producers meeting the criteria for aquaculture listed in the introduction to this document must ensure that all farmed product is labeled properly as "farm-raised" and is not mixed with products that would be classified as wild-caught under these standards.

Appendix A:
Benthic Impacts

Background

Metabolic waste materials (feces and pseudofeces) deposited from molluscs to the sediments beneath or nearby mollusc farms can cause organic material to accumulate in the benthos (i.e., bottom habitat). If enough organic matter is present, impacts can include reduced oxygen content in the sediments, reduced biodiversity, and high sulfides, which are toxic to oxygen-dependent organisms. In general, the effects of mollusc culture on the benthos are of less concern than those of net pen systems for finfish because bivalve molluscs consume natural phytoplankton, with no additional feed. Still, impacts can occur on mollusc farms.

Organic input to the benthos is a balance between the deposition of organic particles from the molluscs, their re-suspension and flushing from the area due to water currents and other factors, and bacterial decomposition within the sediments. Coastal bays and estuaries, which typically are favorable areas for shellfish aquaculture, may also be calm enough to favor deposition, rather than flushing, of organic material. Deposition of organic material is problematic because it can result in excess oxygen consumption by bottom-dwelling bacteria, leading to hypoxia (low oxygen) in the sediments, and possibly extending into the water column. Sulfides can accumulate in the sediment as a result of anaerobic (absence of oxygen) processes such as sulfate reduction, and are toxic to aerobic (oxygen-dependent) organisms. Coupled with low oxygen, such conditions are problematic for benthic communities.

In addition, coastal ecosystems are often affected by runoff from land-based sources such as agricultural fertilizers. Further loading from aquaculture that is too dense or sited poorly can push a site towards low oxygen stress. In other words, excess nutrients from agriculture or other sources, as well as wastes from shellfish farms, can have the same effect: they can push a site towards low oxygen stress. For this reason, comparison with reference stations is essential to determine if effects on bottom habitats actually stem from aquaculture activities, or are present in surrounding areas due to other causes.

Because the United States currently does not have a standard for, or require monitoring for benthic impacts, we have used Canadian government protocols for guidance. These standards are based upon established Canadian protocols developed and tested over 15 years.

Sampling locations:

There are generally greater sediment effects closer to the farmed area than at a distance. This spatial difference necessitates a sampling design which considers both farm samples as well as reference samples (i.e., from areas not influenced by the farm). In year 1, producers will work with benthic experts contracted by Whole Foods Market to determine the appropriate areas to sample (both culture areas and reference sites). These sites will be consistently sampled.

Sediment samples will be taken at a minimum of two locations, potentially with replicates: 1) a location within the boundaries of the farm culture area; and 2) a reference site to provide a comparison with non-farm conditions. The reference sites are ideally similar to the farm site in depth, distance from shore, and sediment type. If a company has multiple leases or farm sites, additional farm and reference samples will be required as. Among the most important criteria in the benthic standards is verification of sampling locations. To do this, WFM utilizes smartphone GPS to deliver sample locations to producers, standardize navigation to sample sites, and verify that samples were taken in the correct place. The Gaia GPS app (IOS and Android) has been designated the optimum approach given its low cost and availability to producers.

Timing:

Samples will be conducted during autumn (in Northern Hemisphere) to incorporate the impact of summer peak production, but without effects of high temperatures.

Data Format:

A standardized template ("Data sheet") is provided in this appendix for recording and reporting data to the Certification Body and Whole Foods Market. Except for relevant notes or comments, a written interpretation of the data set is not required from producers. In addition, a checklist of steps for sampling and recording data is provided.

Level 1 Pre-screening using Visual Redox Assessment

Prescreening samples using the Visual Redox Assessment method will be collected by producers independently, using the WFM specified method. WFM developed an extensive set of training materials to show producers how operate the Gaia GPS app as well as how to sample sediments. This method simply requires producers to obtain a clear acrylic tube to take sediment cores and provide digital photographs of the cores as specified below.

Data from Pre-screening will be used to establish whether farms require further testing via more rigorous Sediment Biogeochemical sulfide analysis. Farms already undergoing Level 2 analysis—Sediment Biogeochemistry—can submit these data and skip the Pre-screening.

Pre-Screening Method:

The pre-screening method requires purchase of a 30 cm section (1 foot long; 3-4 inches diameter) of clear acrylic or butyrate tubing and fitted end caps, commonly available at home supply stores or a plastics retailer. We suggest buying 2 pieces with caps as prevention against loss or damage. Each piece with caps should cost about $10. If the piece is newly cut, the edges should be sandpapered since this material can be jagged. It is important to treat the tubing with some care since scratches will decrease the quality of photographs. This will also happen naturally over time as it is inserted into abrasive sediment. Use of a clear acrylic tube with caps is required. *Sampling with other vessels, such drinking classes or mason jars, is not acceptable.*

The best way to obtain <u>cores in subtidal environments</u> is by an experienced diver, although if a grab is available it is acceptable to subcore from a boat (see grab instructions below; they are the same for Level 1 and 2). Cores are inserted vertically into the sediment to about halfway up the core. The top lid is then applied. The cores cannot be simply pulled out at this point, since the sediment will remain behind. The easiest method of extraction is to reach a hand beneath the sediment and cap the bottom in place. In coarser sediments it may be necessary to twist or tilt the core slightly. *However, it is important to maintain the core in an upright position at all times once removed.*

For <u>intertidal culture</u>, the core is inserted by hand into sediment at low tide in a location *without standing water*. The steps are as follows:

Step #	**What to Do:**
1.	Go to the first pre-selected waypoint
2.	Look at the sediment surface nearby for the presence of animals. Photograph about 1 square meter of the sediment surface and include a ruler in the photo for scale.
3.	Find where you are going to push in your core and be sure that the surface is free of: • Standing water • Shells and other large debris • Footprints • Farm equipment (bags, racks, pvc pipes)
4.	Push the core into sediment at least 10cm
5.	Twist core to loosen and pull core up out of sediment gently; apply the bottom cap.
6.	Measure the depth of the color change by looking at the tube
7.	Photograph the entire core
8.	Write down the aRPD and the time (see data sheets)
9.	Take photo of the sediment surface, adjacent to where the core was taken. The photo should be of an area 1-2 feet wide, on the ground, with a ruler included for scale.

Assuming that the cores are photographed within 1 hour of collection, they do not need special care except to remain upright. They may be stored in dark cool conditions for slightly longer, although photographs must be taken within 2 hours. It will be necessary to wipe water or sediment from the core prior to taking the photograph. If the overlying water is cloudy, the sample has been compromised, and the photos will be unacceptable.

<u>Core photographs must:</u>

1. Contain longitude and latitude embedded in the photo file to verify sampling location. (Photos taken by smartphone, using Gaia GPS App with “location services” turned “on,” will automatically have this information included)

2. Have clear overlying water (for subtidal cores only)
3. Have no shadows or glare that obscure contrast
4. Are taken close-up to allow any viewer of the photograph to see the sediment and its color change.
5. Are taken with the core vertical in the photo
6. Show a ruler next to the core.

Two photos are required for each sample location:

1. A photo close-up of the side of the tube showing the sediment color change. The full-width of the tube should be visible.

2. For intertidal samples: a photo of the adjacent sediment surface is required. **OR:** For subtidal samples: a photo looking at the side of the tube from a downward angle to show the entire sediment surface and the color change.

IMPORTANT NOTE: The full width of the core must be visible in all images

The quality of the photos should be inspected by the producer at the time that cores are still available and re-taken if necessary. If the color change can be seen by the eye, it must also be visible in the photograph. Although close-ups are encouraged, the full width of the core must be visible in all images.

Photos are to be emailed to: WFMGlobalSeafoodPerishablesCompliance@wholefoods.com with appropriate file names (see details in training materials).

Alternative analyses
In some cases, government regulatory agencies require environmental monitoring that exceeds WFM standards. Examples include measurements of sediment geochemistry and biodiversity. In these cases, data available from those monitoring efforts may substitute for the WFM standards when the former provide superior assessment capability. WFM must be consulted to utilize these alternative analyses.

Exceptional environments
There are cases, such as farms whose sediments are comprised of fluid subtidal muds, where the Visual Redox Assessment is less practical. In these situations, producers are encouraged to work with WFM to find solutions.

Level 2 Sediment biogeochemical method using Sulfide Analysis

Level 2 Analysis is required only in situations where Level 1 Pre-screening showed sub-optimal benthic health. Producers requiring Level 2 Analysis will likely need to work with industry consultants or partner with a local university, as the analyses are complex.

NOTE: Level 1 sediment collection at subtidal sites also requires use of divers or a grab. The instructions for these methods are below. Use of a grab or divers does not mean that Level 2 sampling is required.

Sulfide Analysis Methods:

Step 1: Collecting the sediment

Subtidal sediments are generally taken with an Ekman grab. A commonly used model is sold by the Wildlife Supply Company in Florida. http://www.wildco.com/Ekman-Grab-Tall-6x6x9-Ekman-grab-only.html). The grab is 6 inches on a side and can easily be managed by hand from a small boat. We suggest using the lead weight kit or user-made weights to provide enough penetration of sediments. The grab is allowed to fall at a controlled rate and settle to the bottom. The line must be vertical or the grab will not trip. Taking slight tension on the line to make sure the grab is upright, the messenger is sent. On the boat, it is essential that water drain off the grab before sub-sampling. This often occurs by itself through the jaws, but otherwise a piece of tubing can be used to siphon off remaining water. The grab can be tilted slightly to pour off some water, but in any case it is important that the sediment surface not be disturbed. Porosity samples cannot be taken through standing water, but the surface of the grab will be wet during sampling. It is possible to tilt remaining water to one side while sampling. Please note that the grab will sample better in muds than sand or gravel. It is also difficult to deploy successfully in a moving boat or in currents. Therefore, samples should be collected when the boat is anchored or tied to a buoy.

Step 2: Sub-sampling

Sediment sub-samples from the grab are taken with truncated 5 ml plastic syringes. A sharp knife is used to slice the end off of the syringe close to where it tapers. Although it is possible to use syringes with the typical black rubber bung on the plunger, those with a plastic disk plunger tend to have fewer problems binding as the plunger is extracted. The goal of collecting the subsamples from the grab surface is to include only the top 0-2 cm sediment depth from 2 locations in the grab by plunging twice with a single syringe. The syringe does not 'suck up' the sediment very well. Instead, it must be pushed onto the sediment at the same time the syringe's plunger is withdrawn. This requires 2 hands into the relatively narrow space of the grab. It is easier when the sediment surface is near the top of the grab. Each syringe therefore includes a 0-2 cm sample followed by the second 0-2 cm pull in the same syringe. The ml markings on the syringe correspond to cm, so these 2 samples should fill the bottom 4 cm of the syringe.

Intertidal sampling
In the case of intertidal sampling, syringes may be plunged directly into the sediment at low tide.

Step 2 Sub-sampling will be performed twice so that two types of samples are taken. The first sample (all 4 cm) is extruded into one of the pre-weighed vials, capped, and placed in a dark/cold container, such as a cooler. This sample will be used for **porosity and organic content**.

The second is taken in exactly the same way and will be used for both **redox and sulfide**. This sample should be left in the syringe, capped immediately with fitted caps, and placed in the dark in a cooler with ice packs. One goal of sediment sub-sampling for redox and sulfide (same syringe) is to keep external air from the sample. Two caveats: the plunger must be as close as possible to the open end of the syringe before sampling. It should not however be popped out beyond this end because it will be too hard to force back in while sampling. When the sample is withdrawn there should be no gap between the plunger end and the sediment surface. If air occurs it is because the syringe has not been pushed into the sediment while the plunger is withdrawn. Second, and easier, there should not be a gap between the sediment at the open end of the syringe and the cap. This is fixed by pushing the plunger gently to force the sediment flush with the open end. It is then capped making sure the cap is well seated.

IMPORTANT NOTE: NEITHER THE VIALS NOR SYRINGES MAY BE FROZEN.

A numbering system must be followed so that the location of the samples can be identified once in the lab. In the field it is useful to place each syringe and vial from each station in a single zip-loc, which can be labeled with a sharpie onsite. In the lab, the vial number is recorded and matched to a location. It can then be separated from the zip-loc. If the syringe is kept with its bag until analysis, it does not need a separate label.

Step 3: Laboratory analysis

Note: This overview of the laboratory methodology does not include safety warnings or other advisories. Some reagents require precautions. Analysts are advised to consult Material Safety Data Sheets for all chemicals used. Some of the reagents may be custom made rather than purchased. Details on these ingredients may be found at: http://www.dfo-mpo.gc.ca/Library/238355.pdf

1) Porosity and organic content

Porosity: In the lab, the syringes are placed in the refrigerator until analyzed as described below. The vials should be processed as soon as possible after collection. They are first wiped to remove external sediment and water, and then weighed with lids on (±0.001 g). Vials are then placed in a 60°C oven overnight. Once removed from the oven, caps are screwed on and the vials weighed again. Change in weight due to water loss is calculated (see attached example). Vials with dry sediment may then be stored in a dessicator at room temperature.

Organic content: For organic analysis, aluminum weighing tins are labeled to match vials (etch label with a blunt tool, e.g. closed sharpie), and weighed on an analytical balance to 5 decimal places (±0.00001 g). After breaking up the sediment in a vial with a small spatula, pieces from a single vial are transferred to a dish, and the dish re-weighed on the analytical balance. The dish+sample are then placed in a muffle furnace at 490-500°C for 3 hours. Once cool, they are re-weighed on the analytical balance. Weight loss is used to calculate organic content. When sediments are removed from the drying oven or the muffle furnace, they gain moisture from the air. If weighed while equilibrating, the weight will be unstable, so they can be exposed to the air for a brief time to avoid this problem.

2) Redox and Sulfide

Redox: Redox measurements require a platinum electrode (called oxidation reduction potential - ORP) containing an internal reference system. The recommended electrode is the Orion

9678BNWP and the filling solution is Orion solution 900011, KCL saturated with Ag/AgCl. Sulfide measurements require an ion-specific sulfide Ag+/S= combination electrode. The recommended model is the Orion 9616BNWP and the filling solution is Optimum Results A solution (Orion 900061). Both electrodes should be filled at least 24h prior to the analysis. This combination of hardware is well tested for these analyses. A pH/specific ion meter is required with millivolt output and electrode input via BNC connector for both redox and sulfide. An Orion 4-Star pH/ISE 1215001 is the suggested model.

The platinum redox electrode is not calibrated per se, but instead checked against a reference solution, typically purchased as Zobell's solution. The electrode is immersed in a sample of the solution and the mV value is recorded compared to the known value for Zobell's. The two values should agree by 30 mV or less.

<u>Sulfide</u>: Sulfide standards for electrode calibration are prepared in concentrations of 10000, 5000, 1000, 500, and 100 micromolar concentrations from a 100000 micromolar stock solution made by adding 2.402 g Na2S*9H2O into a 100 ml volumetric flask and diluting to 100 ml with de-oxygenated water. Sodium sulfide is hygroscopic and crystalline in nature. Large chunks should be ground before weighing for the stock solution. The concentrate is stable for several days if stored airtight in a refrigerator. The sulfide standards <u>must</u> be made with de-oxygenated water. This is created by either boiling or bubbling distilled water with nitrogen gas. The former method requires a long cooling period and will delay the calibration. Water prepared in this way must be stored with no headspace.

Sulfide anti-oxidant buffer (SAOB) is used to stabilize sulfide samples. It may be purchased as Orion SAOB II Reagent Pack 941609. Just prior to the analysis, 8.75 g of L-ascorbic acid is mixed into 250 ml of SAOB. This solution must be used within 3 hours.

Appropriate dilutions with deoxygenated water are used to dilute the stock and prepare the standard series listed above. The standard series must be prepared each day. Most analyses are conducted over a single day, so the series need be made only once. The calibration measurements are made in scintillation vials with equal quantities of each standard and the SAOB ascorbic acid solution. Millivolt readings are recorded for each standard, beginning with the lowest standard and proceeding to the highest.

<u>Redox and Sulfide Sample Analysis</u>:

Both the redox and sulfide sample analysis involve lumping of the top 2 cm of the sediment surface, as obtained in the syringe sample. Ideally samples should be analyzed within one day of collection, but they have a maximum storage of 72h. For the analysis, the syringe is first expelled into an empty scintillation vial or similar sized beaker, and redox must be done first. The redox electrode is inserted and may be stirred gently. The redox value in mV should stabilize quickly, in <1 minute, settling at a fairly constant value. If left too long, redox will begin to rise; an excess period of redox measurement will also allow sulfides to escape. As soon as redox is recorded, SAOB is added in a volume equal to the sediment volume, usually about 4 ml. If all sediment samples were plunged to 4 cm total, the SAOB pipette can be set to a constant 4 ml. This will stabilize the sulfide sample. The calibrated sulfide electrode is then inserted and measurement made as with redox (< 1minute). Excess time with the probe in the sample will eventually produce increased sulfides as the reagents begin to extract mineral sulfides. Electrodes can be rinsed with distilled water between measurements.

Although it is possible to use the meter to output sulfide concentration in micromolar units, this is not recommended. Instead, the millivolt reading is recorded and used in a calibration regression based on the standards of log10 S vs. mV which should have a slope in the range of -28 mV. This is then used to calculate μM concentrations from the samples. For redox, the value of the internal reference (known from the electrode specifications) is added to the recorded mV value to determine Eh. There is some temperature sensitivity in this correction but it is small compared to the variance in the measurements.

Results:

The interpretation of sulfide and redox values is more oriented toward ranges than rigid values. Low concentrations of free sulfides (<500 micromolar) are not often differentiated. For example, i.e. 300 and 400 micromolar values are both so low that they would not be distinguished from each other. Redox has even coarser distinctions, with no distinction possible between sediments of 100 to 200 mV. The standards are therefore based on ranges of concern.

Whole Foods Market
Benthic Sampling Audit Checklist for Bivalve Mollusc Quality Standards
Version 2.0
January 1, 2015

Supplier Name and Company: ____

10.0 Benthic Impacts

Std #	**Check-list #**	**Requirement**	**Initial here to show step completed**
CB	10.1	The number of sites sampled corresponds to the number requested by WFM. If the number is different, supplier provided justification for changes to WFM and has submitted evidence of this notification to CB.	
CB	10.2	The location of the sites sampled and photographed corresponds to the locations requested by WFM (the "pre-selected" waypoints). If the locations are different, supplier provided justification for changes to WFM and has submitted evidence of this notification to CB.	
		The proper equipment was used for core sampling. • Clear acrylic tubes were used and are OPEN AT BOTH ENDS. • A bottom cap must be used if any water is covering sample location, regardless of whether the site is considered intertidal or subtidal for legal purposes. • Top caps must also be used if the entire core is underwater during sampling. The top cap should be applied after the core is inserted into the sediment, but prior to removal.	
CB	10.3	Photographs:	
CB	10.3.1	• Photographs were taken with a smartphone or GPS camera and the longitude and latitude of each photograph are embedded in the jpg image.	
CB	10.3.2	• The entire core is visible, the aRPD is clearly visible, there is no glare in the photos and they're not blurry.	
CB	10.3.3	• Ruler is included in each photograph of the core and the numbers on the ruler are clearly legible.	
CB	10.3.4	• For intertidal farms: At each location, photograph provided of the sediment surface with a ruler in the photo to identify whether or not signs of fauna, such as snails or clam holes, are present.	
CB	10.3.5	• For subtidal farms (OR any farms that are not completely exposed at low tide, regardless of legal classification): At each location, photograph of sediment surface INSIDE the core shows presence or absence of fauna (best seen from oblique view of core). If water is very shallow and clear, and bottom can be seen through the water, please also send a photo of the sediment adjacent to where sample is taken.	
CB	10.3.6	• Names of the photographs (i.e. the file name for each photo) correspond to the naming convention specified by WFM, including the sample site name and the farm or reference designation. For example: The first farm	

		sample for Joe's Oyster Farm would be named: JOF.F.1. If there are multiple photos submitted for a single sample, add a, b, c, etc. to the end of the file name. NOTE: GAIA does not maintain photo names when emailing directly from the program, so it is best to email the photos to yourself, rename on your computer and then email to WFM and the Certification Body (CB)	
CB	10.4	Supplier measured the depth of the color change (aRPD) for each sample and recorded it on the data spreadsheet in centimeters.	
CB	10.5	Supplier recorded presence or absence of fauna on the data spreadsheet for each sample (indicated with "yes" or "no").	
CB	10.6	Data spreadsheet matches template provided by WFM.	
5.1	10.10	Benthic samples were collected in the autumn and submitted to Whole Foods Market by October 15th (April 15th in the Southern Hemisphere) If audit was conducted on-site, auditor oversaw sample location and sample quality as well as the photography of the samples.	
5.1	10.11	Mitigation plan to reduce anoxia, if required by auditor, submitted to CB.	
CB	10.12	Results from other environmental impacts assessments (e.g. by local government or independent research) available on site or have been submitted to auditor for desktop audit.	

Comments:

Benthic Monitoring Data Sheet

Company name:________________________

Samples taken by:______________________

Tube diameter used:____________________

Date	Time	Site name	Water Depth at Lowest Tide	Photo ID	Sample Name	aRPD depth (cm)	Comments	Fauna? (indicate yes or no)	Comments

Appendix B
Ecosystem Carrying Capacity

Significant efforts are underway in the field of mollusc research to understand and assess the broader effects of mollusc aquaculture on the environment. Evaluating the capacity of ecosystems to handle potential environmental impacts of mollusc aquaculture is an extremely active area of research today. Although feed inputs are not used with mollusc aquaculture, there is still potential for environmental impacts to occur. The two main concerns with mollusc aquaculture are that: 1) at high enough densities of animals on a farm or of farms in an area, wastes from the grow-out animals can lead to benthic organic enrichment and oxygen depletion; and 2) molluscs can deplete food resources, such as phytoplankton, upon which other species, including wild filter-feeder populations, rely. Both of these issues may lead to changes in biodiversity in the area and competition for space or other resources.

It is generally acknowledged that on mollusc farms, as with other forms of aquaculture, some level of change occurs in the area immediately beneath or surrounding the farm as a result of farming activities. However, determining if impacts from an individual farm are localized only to the immediate area, or if the farm has an impact on the larger ecosystem, is extremely difficult. This type of knowledge requires an understanding of both the *assimilative* capacity of the system to accept benthic waste so that oxygen depletion does not occur and the *carrying* capacity of the system to provide adequate food resources (e.g. phytoplankton) so that depletion does not occur. To date, not enough research has been done, especially on assimilative capacity, to require evaluation of carrying capacity by individual producers on an ecosystem scale.

Typically, assessing the carrying capacity of an ecosystem requires evaluation on a bay-wide scale (or other water body), whereby the capacity of the ecosystem to assimilate wastes and impacts of *all* the production of mollusc aquaculture in the area (*not one individual farm*) is assessed. Assessing the carrying capacity of an ecosystem and setting an appropriate standard for an acceptable level of impact requires participation by all producers in the growing area (i.e., all producers in the ecosystem). This type of participation should be coordinated and implemented by natural resource managers or regulators who are responsible for overseeing the use and management of natural resources and activities on regional scales. In practice it is not feasible for individual producers seeking to meet the quality standards of one company, such as Whole Foods Market, to determine if their farming activities are exceeding the carrying capacity of the entire ecosystem, especially if they're the only producer in an area seeking to meet the standards.

In addition, ecosystem models, while fully operational today, require specialized personnel to run and analyze data. Furthermore, ecosystem models or other measures of carrying capacity still lack well-defined impact thresholds, making it difficult to establish an accepted standard. Whole Foods Market encourages research to test ecosystem models. However, based on these factors, the Whole Foods Market Quality Standards do not require producers to assess the carrying capacity of the ecosystem.

However, it is Whole Foods Market's goal to see individual producers work toward having accurate assessments of any environmental impacts from their farms. Whole Foods Market seeks to partner with producers that are proactive and explore tools such as the Farm Aquaculture

Resource Management (FARM) software (http://farmscale.org/), which allows farms to determine the appropriate shellfish density for optimal carrying capacity (i.e., the greatest sustainable yield of market-sized animals within a given time period). We note, however, that this type of farm evaluation tool does not set a standard for what the acceptable level of impact should be. However, it can help to provide the data to move in that direction. Overall, Whole Foods Market seeks to maintain natural species communities, while at the same time supporting mollusc aquaculture due to the suite of benefits it offers, including significant ecosystem services, such as the mitigation of eutrophication symptoms and provision of healthy foods.

Appendix C. General Guidelines for Group Certification

Required steps for group certification:

1. Each farm owner that participates in the group certification process must fill out their own Operator Profile (OP). *The OP should be filled out by the farm owner, not by the Internal Control System Manager*.

2. The Internal Control System (ICS) Manager submits the following to Whole Foods Market Seafood Compliance Team in order to be considered for Group Certification:

   - Complete Operator Profiles for all group members
   - Demonstration (through completed audit checklists) that the ICS manager has conducted *internal* on-site audits of 100% of the participating farms to ensure that the Whole Foods Market standards are being met. Internal audits must be done *prior* to the Certification Body's external third-party audits. The ICS manager may use the Whole Foods Market audit checklist to conduct internal audits.

3. The ICS Manager signs a contract with the Certification Body.

4. External third-party audits are conducted by the Certification Body and cover the following main components:

   Audits of the ICS manager:

   - The ICS manager will receive an audit during *each* audit cycle to evaluate administration of the internal control system to ensure that it's working effectively. The first audit must be an on-site audit to fully assess if the ICS manager is able to adequately manage the requirements of group certification. The ICS manager must pass the audit to move forward with group certification. The following two audits in the audit cycle will be desktop audits unless the auditor determines that an on-site audit is required.

   - Each audit: the Certification Body verifies that the ICS manager keeps up-to-date OPs on file for each farm owner in the group.

   - The Certification Body verifies that the ICS manager is conducting internal audits of group members. Audit checklists, with any noted non-compliances and demonstration of the resolution of these non-compliances, can be used to demonstrate completion of internal audits.

   Audits of a sample of the group participants:

   - The number of farms audited each cycle is calculated as the square root of the total number of farms. For example, if there are 20 farms in the group, 5 farms will be audited by the Certification Body in every audit cycle. During the first audit cycle, a sample of the farms will be audited on-site (total of 5 in the example above); for the following two audit cycles, audits would be conducted remotely.