

## GEODUCK AQUACULTURE ENVIRONMENTAL MONITORING PROGRAM

The Department of Natural Resources (DNR) will undertake, in conjunction with the Lessee, an environmental monitoring program to determine the effects of geoduck aquaculture on ecological processes, habitats and species of concern on SOAL. The results from this program will assist DNR in reaching its Goals and Long-term Objectives. Specifically, the information will test the efficacy of Best Management Practices, to ensure they are effective and adequate.

The Department of Natural Resources realizes that these monitoring and analysis results will not answer all questions, and therefore will submit legislative budget requests for additional research studies (to include impacts on fish, birds, entrapment, debris, and recreational uses) and monitoring for genetic impacts, impacts on salmonid (ESA) species, and other effects.

### Goals

1. Determine whether geoduck aquaculture on SOAL has a statistically significant impact on ecological processes, habitats and species of concern at varying tidal heights and with full range of types and levels of activities and structures
  - a. Determine impacts during a growing cycle and recovery period from different types of culture practices for geoduck aquaculture on:
    - i. Epifaunal and infaunal diversity (taxa richness) and abundance.
    - ii. Sediment total organic carbon levels (TOC)
    - iii. Sediment grain size distribution
    - iv. Sediment redox profile
    - v. Bed extent of eelgrass and macroalgae onsite and immediately offshore/offsite (waterward of leasehold to lower limit of vegetation).
2. Conduct a survey to document any potential shellfish treaty rights, in compliance with the Rafeedie decision.

### Long-Term Objectives

1. Detect changes in infaunal and epifaunal and epifloral diversity and abundance as measured against lease baseline and control site conditions.
2. Detect changes in TOC and sediment grain size distribution as measured against lease baseline and control site conditions.
3. Detect changes in eelgrass and macroalgae, as measured against lease baseline and control site conditions.

### **Monitoring Program Structure**

Lessees will conduct environmental monitoring during the first ten-year lease cycle and submit all data to DNR.

DNR will conduct statistical analyses of the results to see if there are significant changes in the performance measures. DNR will use the results to modify conditions of future leases, require mitigation in future leases, and focus research studies on areas in which effects are seen

Not every lessee will conduct monitoring. A limited number of sites—at least two acres in size that are representative of that given region—will be used. This will consist of at least one site each for north Puget Sound, south Puget Sound and Hood Canal. Other sites leased under the request for offers (RFO) system will not be asked for a proposal of ongoing monitoring.

DNR will only require monitoring at those sites leased in the first few years of the leasing program, and only for the first growing cycle of those leases, so that the monitoring will be completed by 2011 or 2012. Some sites (or portions of sites) will be left fallow after the harvest in order to monitor and document recovery.

BMPs for the sites leased outside of the monitoring program will be amended to address information collected in the ongoing monitoring program

### **Control Sites**

Impacts will be determined through the use of on-site baseline and on-going sampling and comparison to control sites. The lessee will be required to conduct sampling at one or more control sites on state owned aquatic lands close to the leasehold. DNR will provide a right of entry for this work. DNR will consider Lessee's input on control site location and number.

### **Sampling Protocols**

DNR and the Lessee, in conjunction with input from other agencies, academia, and industry, will finalize sampling, analysis, and data storage and distribution protocols, including a QA/QC plan. Epifaunal and infaunal sampling will be based in Puget Sound Assessment and Monitoring Program (PSAMP) protocols, sediment protocols will be based on Department of Ecology's Coastal Estuarine Monitoring and Assessment Program (EMAP) Sediment protocols, and eelgrass/macroalgal bed extent may use aerial photography.

Site heterogeneity will vary, therefore baseline sampling will be used to determine the number and location of samples needed in order to make a statistically valid inference about change.

Sampling will be designed to detect a 20% change over a one-year period with 90% confidence. Repeated sampling of fixed stations, rather than random samples, will be used in order to make pair-wise comparisons. This will be a more efficient method of sampling in order to detect changes.

### **Activity Logs**

In order to determine whether impacts are from aquaculture activities or from other stressors, the Lessee will provide to DNR monthly logs of all activities on or adjacent to the site. These will include time, locations, types of boats and motors used, access types (water or land), equipment employed, and number of people.

### **Environmental Monitoring**

1. Baseline (pre-activity) Monitoring Events
  - a) A survey to document all 'Rafeedie' organisms<sup>1</sup> will be conducted prior to any activities taking place. The survey will be used to determine any potential treaty rights to existing shellfish. The survey methodology for littleneck clams and butter clams will be similar to the Washington Department of Fish and Wildlife (WDFW) methodology for intertidal beaches. [Attached- Appendix A] The survey for geoduck and horse clams will be a modification of the WDFW subtidal survey method [attached- Appendix B] and will be an "all count" survey as opposed to a transect/extrapolation survey.
  - b) Map intertidal and adjacent subtidal eelgrass and macroalgae (seaweeds). Aerial photography may be used to delineate eelgrass bed area.

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<sup>1</sup> These are defined as "all harvestable shellfish", to include but not be limited to: [list common+scientific names] [Give reference to court's definition?]

- c) Determine sediment and water quality parameters as outlined below.

**2. Ongoing on-site and control site monitoring for Sediment and Fauna**

The monitoring of sediment, benthic fauna and epibenthic fauna is designed to detect changes caused by geoduck aquaculture, as measured against the lease baseline and control site conditions. Information from debris monitoring will also be collected.

a) *Sediment and fauna survey:*

I. *Metrics:*

I. Site description

- a. Tube density
- b. Geoduck density
- c. Netting or other predator control measures

II. Benthic infauna and epifauna,

- a. SCALE method- Pair-wise repeated sampling at same sites, not random sampling.
- b. Done under contract with an accredited laboratory.

III. Debris

- a. Accounting and quantification of loose tubes, netting, including off-site (down drift) for an appropriate distance (site-specific) from the site.
- b. Accounting of debris from the aquaculture operation and other (non-aquaculture) debris will be noted.
- c. Information will be collected in the activity log.

IV. Sediment Characteristics

- a. Temperature
- b. Interstitial conductivity (salinity)
- c. Interstitial water pH
- d. Redox depth profile
- e. Total Organic Carbon (TOC)
  - i. Done under contract with an accredited laboratory.
- f. Grain size distribution,
  - i. Washington Department of Ecology. 2003. *Sediment Sampling and Analysis Plan Appendix: Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC)*. Ecology Publication No. 03-09-043 Revised April 2003
  - ii. Plumb, R.H., Jr. 1981. Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1. U.S. Environmental Protection Agency and U.S. Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.
  - iii. Done under contract with an accredited laboratory to these parameters:

Parameter Codes	
Parameter	Description
% Solids	percent solids
% Gravel	percent >2000 µm

ParameterCodes	
Parameter	Description
% Very Coarse Sand	percent 2000-1000 µm
% Coarse Sand	percent 1000-500 µm
% Medium Sand	percent 500-250 µm
% Fine Sand	percent 250-125 µm
% Very Fine Sand	percent 125-62.5 µm
% Sand (Total)	percent 2000-62.5 µm (total sand)
% Silt	percent 62.5-3.9 µm
% Clay	percent <3.9 µm
% Fines	percent <62.5 µm (silt + clay)

*II. Schedule:*

The actual timing of the sampling will be dependent on the actual culture practices of the company. The site should be sampled before and after each of the following activities: placing tubes and seed, removing tubes and seed, harvest. Periodic sampling will be conducted if the activities extend longer than a 6-month period. A proposed schedule for sampling On-site and control may be as follows:

1. Immediately prior to tube installation and seed planting (less than one day)
2. One month after tube installation
3. Every six months thereafter between tube installation and removal
4. Immediately prior to tube removal (less than one day)
5. Immediately after tube removal (less than one day)
6. One month after tube removal
7. Six months after tube removal
8. Annually thereafter until harvest
9. Immediately prior to harvest (less than one day)
10. Immediately after harvest (less than one day)

Monitoring will be conducted at low tide for sediment/plant parameters. Sampling will be conducted at the upper, mid and lower parts of the planted beach area for sediment/ benthic infaunal and epifaunal/plant metrics.

**3. On-going on and off-site eelgrass and macroalgal monitoring**

The monitoring of eelgrass and macroalgae is designed to detect changes in the extent of coverage, as measured against the lease baseline and control site conditions. The monitoring is designed to detect gross changes in bed delineation, and impacts from barges and boats used at the site. Changes in turion (plant) density will not be measured.

The actual sampling methodology is being finalized. One proposed sampling method might include using aerial photography using natural color film flown at a scale of 1: 6,000 or less taken at extreme low tides, calm winds, and low turbidity. Photographs will be along the shoreline at the very seawards edge of the lease to monitor changes in eelgrass and macroalgae. The photographs will be used to detect change in the edge of the bed (from impacts from siltation, water turbidity) or direct impacts (scarring) from propellers, grounding, anchors, digging), and changes in macroalgal cover greater than 50% cover.

The actual timing of the sampling will be dependent on the actual culture practices of the company. The site should be sampled before and after each of the following activities: placing tubes and seed, removing tubes and seed, harvest. Periodic sampling will be conducted if the activities extend longer than a 6-month period. A proposed schedule for sampling On-site and control may be as follows:

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3. Every six months thereafter between tube installation and removal
4. Immediately prior to tube removal (less than one day)
5. Immediately after tube removal (less than one day)
6. Annually thereafter until harvest
7. Immediately prior to harvest (less than one day)
8. Immediately after harvest (less than one day)

**4. Data**

All data (to include but not be limited to: field notes, data sheets, photographs, videography, digital files) will be copied and provided to DNR within one week of collection or receipt of results.

**Post-harvest Recovery Monitoring**

On-site and control sites will be monitored for eelgrass, macroalgae, infaunal and epifaunal biota, and sediment characteristics. Water quality will not be monitored. Sampling will be conducted 1, 6 and 12 months after harvest.

**Data Analysis**

Data analysis and reporting will be the responsibility of DNR. All results will be immediately shared with DNR by the Lessee.