June 30, 2014

Mason County Department of Community Development
Attn: Grace Miller, Senior Planner
411 N. Fifth Street
PO Box 279
Shelton, WA 98584

Re: Geoduck Floating Nursery Monitoring Plan, Quarterly Reporting
12755-01

Dear Ms. Miller:

We present here the results for the fifth quarterly monitoring of the Seattle Shellfish geoduck floating nursery at Spencer Cove, Harstine Island, conducted on June 4, 2014. A full year of monitoring has been completed, and will be summarized in the Annual Monitoring Report in July 2014. This work has been performed in accordance with our agreement dated October 2, 2012, and covers work through June 30, 2014. Continued activity during this period included light readings, photographs, depth measurements, and fish counts taken from the five established locations on the log boom adjacent to the floating nursery beds. Recall that five sites were selected on May 31, 2013, to evenly cover the full length of the nursery beds, and were permanently marked on the log boom. Site one was established at the north end of the log boom, with site five at the southern end.

As in our other quarterly monitoring, light readings were taken with a Li-Cor spherical quantum sensor off the east and west sides of the log boom, with readings underneath nursery beds where present. Nursery beds are occasionally moved, so site-specific light readings vary. Photographs were taken in the four (approximate) compass directions at each site, in order to capture the surrounding location and water conditions. Depth measurements were taken at the point of each light reading. Depth was considered accurate to the nearest 10 centimeters (cm), given the soft sediment and poor visibility to the bottom, but localized currents and wave action can cause readings to vary by 0.5 meter (m) relative to mean lower low water (MLLW). Similarly, fish schools greater than ten fish were estimated to the nearest ten fish.

Site and Species Observations

Species of algae attached to the log boom and nursery rafts is consistently dominated by laminarian kelp, but a greater diversity of algae had returned for the spring and summer months. Algae species present included Ulva sp. (green algae), Fucus sp. (rock weed), and Sargassum (wireweed). Laminarian kelp has consistently been found in greater density and length on the east side of the log boom, and is also present along the sides of the nursery rafts.
The invertebrate species complex has also been mostly consistent between quarterly monitoring at all five sites. Invertebrates are dominated by sessile species attached to the log boom or on laminarian kelp. These included bryozoans, hydroids, mussels, barnacles, tube worms, and Metridium anemones. Mussels (Mytilus sp.) and barnacles were the dominant species present, in contrast to previous monitoring where hydroids were dominant. These are native species to Puget Sound and are common on docks and floating structures.

No fish were observed near the log boom, but several pelagic invertebrates were present at Sites 2, 3, 4, and 5. These included moon jellies (Aurelia aurita), egg yolk jellies (Phacellophora camtschatica), ctenophores, and hydroid jellies. These species are associated with high plankton blooms that have occurred since the March monitoring. The only birds observed nearby were gulls.

There were nine platforms attached to the log boom this monitoring period. Five of the platforms were nursery rafts, three were for supplies and equipment, and one was a boat moored to a supply raft. The nursery rafts were present on the east and west side of the log boom between Sites 4 and 5 (Photograph 15), and on the west side of the log boom at Sites 1, 2, and 3 (Photographs 3, 7, and 11). Organic debris between the log booms and rafts was only present on the west side, and consisted of mostly green algae and pollen (Photograph 7). Organic debris and detritus, such as pine needles and leaves, move in relation to the tide, and can be found in greater abundance between different rafts depending on a flood or ebb tide. Detrital abundance is also seasonal, dependent on terrestrial plant growth cycles.

**Light and Depth Readings**

Weather was cloudy with no wind, and there was no wave action against the log boom. Reported depths are corrected relative to mean lower low water (MLLW), based on tidal height from the closest NOAA tidal reference station (McMicken Island, Case Inlet). All south Puget Sound tides are based on the Elliot Bay NOAA buoy in Seattle. Light levels are reported in micro-einsteins. Light attenuation levels, calculated from the difference between surface and bottom light levels, are reported as a coefficient per meter (K(m-1)). Greater attenuation coefficients indicate greater light absorption levels in the water column, as, for example, from turbidity or plankton. A large attenuation coefficient means that light is quickly attenuated (weakened) as it passes through the water, and a small attenuation coefficient means that the water is relatively transparent. The daily and seasonal angle of the sun also affects in-water light readings because of surface reflectance and scattering through the water column.

Average attenuation coefficients were the highest (at 0.72 K(m-1)) since monitoring began in May 2013 (Table 1), despite the decreased angle of the sun (closer to vertical) found in spring and summer months. There were strong spring phytoplankton blooms throughout May and into June, resulting in poor water clarity. Attenuation coefficients averaged from 0.75 to 0.70 K(m-1) for the east and west sides of the log boom, respectively, with an average difference between sides of 0.05 K(m-1). Previous
monitoring found attenuation coefficients with an average difference ranging from 0.04 to 0.11 K(m-1) between the east and west sides. Neither side has had predominantly greater attenuation coefficients. The lowest attenuation coefficients for June 2014 were at Sites 4 and 5, which had rafts on both sides of the log boom. This suggests that the high coefficients were affected by the plankton bloom more than by any shading effect from the rafts. The attenuation coefficients were lower than a threshold value of 1.0 K(m-1), at which light availability is limiting for eelgrass and phytoplankton growth in estuaries beyond 6 meters in depth.

The site was visited again on June 17, 2014, for the annual dive survey. Light readings were not taken, but the water clarity was notably improved, with divers visible from the surface down to two meters. We do not believe that light attenuation caused by the log boom or nursery rafts in June was high enough to significantly affect biological productivity of benthic photosynthetic organisms.

### Table 1 – Light Readings and Fish Counts (June 4, 2014)

<table>
<thead>
<tr>
<th>Site</th>
<th>Time</th>
<th>Depth (m; MLLW)</th>
<th>Light, Surface (micro-einsteins)</th>
<th>Light, Bottom East (micro-einsteins)</th>
<th>Light, Bottom West (micro-einsteins)</th>
<th>Attenuation Coefficient, East (K(m-1))</th>
<th>Attenuation Coefficient, West (K(m-1))</th>
<th>Fish Species</th>
<th>Fish Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10:38</td>
<td>3.14</td>
<td>314</td>
<td>27.5</td>
<td>32.9</td>
<td>0.77</td>
<td>0.72</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>10:48</td>
<td>3.09</td>
<td>151</td>
<td>10.0</td>
<td>18.1</td>
<td>0.68</td>
<td>0.69</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>11:00</td>
<td>3.32</td>
<td>323</td>
<td>25.1</td>
<td>20.8</td>
<td>0.77</td>
<td>0.83</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>11:11</td>
<td>4.67</td>
<td>387</td>
<td>19.8</td>
<td>22.6</td>
<td>0.64</td>
<td>0.61</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>11:21</td>
<td>3.90</td>
<td>485</td>
<td>34.0</td>
<td>36.0</td>
<td>0.68</td>
<td>0.67</td>
<td>None</td>
<td>0</td>
</tr>
</tbody>
</table>

### Summary

Quarterly monitoring of June 2014 represented the fifth monitoring at the Seattle Shellfish geoduck nursery beds. Light attenuation levels were greater than at other monitoring events, but they were affected by strong phytoplankton blooms, and do not appear to be a result from the nursery rafts or other platforms. Dept1 readings varied relative to MLLW and were shallower than the previous observation, but were, overall, consistent overall with findings since the surveys began in May 2013. Depth readings were taken during a slack tide with no wind or waves, but barometric pressure and shoreline features can also affect the accuracy of depth. Soft sediment bottoms are also more dynamic than rocky substrate features. We will continue to monitor depth quarterly from the surface.

Depth readings help monitor for any potential sedimentation from the nursery rafts. There was a shallower depth reading than in March 2014, but it was deeper than the first monitoring in May 2013, suggesting that no sediment accumulation from the nursery rafts has occurred. Depth readings were taken during diving surveys in June, when visual assessment of any sedimentation were made. Species of algae and invertebrates were consistent with previous observations, and no fish were observed this
monitoring period. Natural seasonal differences in light availability and algal growth were observed, as reflected in surface light levels and the attenuation coefficients.

A complete analysis comparing results between quarterly monitoring will be provided in the July 2014 annual report. The next quarterly monitoring will occur by early September. Please do not hesitate to call if you have any questions regarding this monitoring report. You can reach me at (425) 329-1157 or by e-mail or cell phone as listed below.

Sincerely,

HART CROWSER, INC.

[Signature]

JAMES SELLECK
Marine Ecologist
(360) 303-8362 (cell)
james.selleck@hartcrowser.com

Attachments:
Photo log of monitoring on June 4, 2014

cc: Jeff Barrett

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Photo Log

Site 1

Photograph 1 – Site 1, facing east

Photograph 2 – Site 1, facing north

Photograph 3 – Site 1, facing south

Photograph 4 – Site 1, facing west
Site 2

Photograph 5 – Site 2, facing east

Photograph 6 – Site 2, facing north

Photograph 7 – Site 2, facing south

Photograph 8 – Site 2, facing west
Site 3

Photograph 9 – Site 3, facing east

Photograph 10 – Site 3, facing north

Photograph 11 – Site 3, facing south

Photograph 12 – Site 3, facing west
Site 4

Photograph 13 – Site 4, facing east

Photograph 14 – Site 4, facing north

Photograph 15 – Site 4, facing south

Photograph 16 – Site 4, facing west
Site 5

Photograph 17 – Site 5, facing east

Photograph 18 – Site 5, facing north

Photograph 19 – Site 5, facing south

Photograph 20 – Site 5, facing west