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July 28, 2002

Ms. Dianne Cooper and Mr. Gordon King  
Taylor Shellfish Farms  
130 SE Lynch Road  
Shelton, WA 98584

and

Ms. Vicki Morris  
Vicki Morris Consulting Services  
7732 18th Avenue N.E.  
Seattle, WA 98115-4426

Re: **Totten Inlet EIS Studies**

Dear Dianne, Gordon and Vicki,

We have been collecting monthly water column, sediment physicochemical, and canister data since April 2002. The mussel genetic survey was completed on June 27, 2002. Intensive monitoring at North Totten and Deepwater Point was completed on July 8, 9, 10 and 17. The following activities have been completed:

- Water from a depth of 2.5 meters has been collected monthly at North Totten and Deepwater Point. The water is analyzed for temperature, salinity, TSS, TVS, chlorophyll and nutrients.
- Canister studies at seven locations continue on a monthly basis. The canister contents are analyzed for TSS and TVS to estimate the quantity and nature of settleable solids as a function of distance from the center of the Deepwater Point farm and at the center of the proposed North Totten Inlet farm.
- Baseline physicochemical and biological data was collected at the proposed North Totten site and similar data was collected at the Deepwater Point mussel farm. Sediment samples have been evaluated for sediment grain size, TVS and sulfides at AES and have been shipped to the University of Washington for TOC analysis.
- Water samples have been evaluated for turbidity, TSS, TVS and have been shipped to the University of Washington for nutrient and chlorophyll analyses.

- Two drogue studies have been completed at the North Totten site using three large window shade drogues set at depths of 2.5, 7.5 and 15 meters. One study was completed on an extreme tide and the other on an exchange to MLW.
- Benthic video was recorded along orthogonal transects at North Totten and Deepwater Point in August.
- The benthic nutrient study has been successfully completed and samples forwarded to the University of Washington for nutrient analysis. This is part of the PSI study.
- The macrofaunal community has twice been surveyed on mussel lines at three depths and two locations (interior and perimeter) on the Deepwater Point farm. This is part of the PSI study.
- Ralph Elston and Kenn Brooks identified permanent study sites for the mussel genetic study on June 27, 2002. Sites were established adjacent to the proposed North Totten site; adjacent to the existing farm at Deepwater Point; and in Skookum Inlet where there are no mussel farms. Too few mussels of any kind were found on sediments at any beach examined by the survey team. Required mussel samples were collected from piling (North Totten), predator fences (Deepwater Point) and oyster dike walls (Skookum). The samples were shipped to Pat Gafney for genetic identification.

No data has been returned from the University of Washington Oceanography laboratory. However, Kathy Kroglund promised much of the data by my return from vacation in 10 days.

To date these data suggest that existing shellfish resources in Totten Inlet, particularly at the Deepwater Point site, are not utilizing even a small portion of the primary productivity. The water there is “pea soup.” Sediments and canister data from the Deepwater Point farm both demonstrate moderately increased biodeposition within 15 meters of the perimeter of this farm. Sediments beyond 15 meters are relatively uniform with respect to deposition rates, sulfides and TVS. However, sulfides are elevated to as high as 416  $\mu\text{M}$  at the Deepwater reference station and to as high as 1,240  $\mu\text{M}$  along the southern transect at North Totten and 1,170  $\mu\text{M}$  in deeper water on the western transect at North Totten where sediments are very fine. These are the highest sediment sulfide concentrations I have observed in several hundred samples collected at reference stations in Washington State, British Columbia and Alaska. My point is that this evidence suggests that Totten is a very rich inlet that is no-where near its carrying capacity for shellfish and other resources. These benthic data are substantiated by the video surveys completed in July that showed dense clouds of benthic diatoms stirred up by the camera’s probe. These bottom video records also revealed a striking difference in transparency as a function tide. Bottom water visibility significantly increased during the transition from ebb to flood tides at North Totten.

I continue to work with PSI in an effort to define specific questions regarding the water column that will be answered by their study and to determine how the data will be

used to answer those questions. It is my understanding that they are successfully collecting a large amount of data. The following recommendations are based on this preliminary (and cursory) examination of the data:

1. Recommend that Gordon King, Dianne Cooper, Kenn Brooks, Kurt Johnson, Joth Davis and Dan Cheney meet at Taylor United in early September to discuss their findings and to determine how the PSI data can be used to supplement Taylor's scientific efforts in support of the EIS;
2. I will write a "Bridging Document" to discuss the relationship between the PSI studies and Taylor's needs within two weeks of that meeting;
3. The Bridging Document will be distributed to the review committee for review. In mid-September, as many members of that committee as are available and willing, should meet to discuss progress in addressing EIS issues.
4. The elevated sediment sulfide concentrations observed at the Deepwater Point reference station and at the proposed North Totten Inlet farm site require additional investigation. I propose the following:

**Expanded Totten Inlet sediment survey.** I recommend that a series of sediment samples be collected starting at the head of Totten Inlet and ending at Steamboat Island. A second set of samples should be collected along a transect running orthogonal to the Inlets long axis near the inlet to Skookum Inlet. Totten Inlet is approximately 7 nm long (13,000 meters) and 1.0 nm wide at Skookum Inlet. I recommend that we collect one sediment sample 250 meters along the centerline of the inlet and at 100-meter intervals on the orthogonal transect. Locations will be documented using differential GPS ( $\pm 3.0$  m accuracy). Two questions will be asked by this exercise, which will require the collection and analysis of 70 sediment samples.

- a. What trends exist in sediment sulfide concentrations, TVS and SGS along each axis? There are a host of corollary questions and relationships that will also be elucidated.
- b. Do those trends suggest a source of the organic matter creating the observed high sulfide concentrations?

These questions are important because opponents of aquaculture may claim that the observed effects at 1,100 meters distance are associated with the Deepwater Point mussel farm. Gordon believes that the flats in Oyster Bay are the source of much of the nutrients and fines in Totten Inlet. The proposed study will evaluate this hypothesis and elucidate the distribution of enriched sediments in the inlet. The cost of this project, not including data analysis and report writing, will be \$5,770.00.

**Expanded water column nutrient and chlorophyll studies adjacent to Steamboat Island at the mouth of Totten Inlet.** The bivalve carrying capacity in Totten Inlet was of interest to the Hearing's Examiner. The increased clarity of bottom water on the flood tide when compared with the ebb tide is interesting and may provide a way of directly and efficiently examining this issue.

An understanding of carrying capacity could be approached by trying to model those factors that influence this parameter (flushing time, nutrient budgets, phytoplankton turn-over times, stratification, etc. etc. etc.). However, the number of variables influencing the carrying capacity is enormous and previous efforts to determine even the flushing time have failed (see Brooks 2001 for a review of these previous efforts). It appears that this issue can be addressed in a more straightforward manner by determining whether or not Totten Inlet is a source of nutrients and particulate organic matter (POM), including phytoplankton, or is it a sink. If Totten Inlet is a significant **sink** for POM, and if the water leaving Totten Inlet is deficient in POM (with respect to productive estuaries), then a more detailed examination of flushing times and other parameters affecting carrying capacity might be warranted. However, if Totten Inlet is a significant source of POM, and the ebbing water contains substantial amounts of POM, then it appears reasonable to purport that Totten Inlet is not near its carrying capacity. In fact, if Totten Inlet is a significant source of POM, then it could be argued that shellfish culture should be expanded to remove more carbon and nutrients from the inlet. Granted this does not address issues related to all of South Puget Sound. However, I am aware of concerns that South Puget Sound is becoming eutrophic, but I am unaware of evidence suggesting that South Puget Sound ecosystems are jeopardized by lack of nutrients.

The question being asked is, "Is Totten Inlet a net sink or source of particulate organic matter." The following study is proposed to answer this question:

- We will collect triplicate water samples at each of three depths (2.5 m, 10 m and 23m, (the channel is approximately 25 m deep measured from MLLW) in the narrow mouth of Totten Inlet between Steamboat Island and Cape Cod. I suspect the water is well mixed in this channel. Nutrient and chlorophyll data from the initial sampling will reveal any stratification existing at that point.
- Eighteen water samples will be collected once each month in August, September, October, November and December of 2002. That period includes high productivity fall months and low productivity winter months.
- Samples will generally be collected on tidal exchanges to MLW. However, additional samples will be collected on spring tides in August and September (36 additional samples).
- On each sampling day, nine samples will be collected three hours before and nine samples three hours after after high tide - requiring a total of 126 samples.
- The samples will analyzed for salinity, temperature, chlorophyll, nutrients, TSS, TVS and turbidity.

- The number of replicates will be re-evaluated after the first two sets of samples when the internal variation and differences in means between flood and ebb conditions are known.
- Annette Stierns can collect these samples with a boat and captain being supplied by Taylor Resources. The cost will be approximately \$7,300.00.

These studies are being proposed to supplement the EIS with additional information based on the results to date. If the additional water column data suggests that Totten Inlet is a significant sink for particulate organic matter and if the concentrations of POM leaving the inlet are reduced to less than those associated with healthy estuaries, then additional studies of one or more of the variables influencing carrying capacity may be required. However, if Totten Inlet is found to be either a source of POM or an insignificant consumer of POM, then further study of this issue should not be required because the PSI study will quantify the POM consumed during the raft culture of mussels. Those consumption rates can be extrapolated to the North Totten farm and an estimate of the net reduction in POM made. I going on vacation until the 7<sup>th</sup> or 8<sup>th</sup> of August – first time in six years!

Sincerely,

Dr. Kenneth M. Brooks  
Aquatic Environmental Sciences