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October 6, 2008

Ms. Diane Cooper
Taylor shellfish
130 SE Lynch Road
Shelton, WA 98584

Dear Diane,

The following comments are provided in response to the request for information included in the Summary of ITR Comments dated March 13, 2008. I will only deal with those comments specifically direct to myself.

Use existing Totten Inlet flushing rate estimates to conduct sensitivity analysis of the above DO and nitrogen/phytoplankton issue; especially focus on worst-case (least flushing, greatest seasonal stratification and low subsurface D.O.)	NF and KB	JN 2 JR 5-7

This is an issue for NF to explore. The question of how low redox sediments affect the overlying water column is an interesting one. But I am unaware of specific studies designed to assess this issue. However, see my comments below.

Revise supplemental study of dissolved nutrients as per comments if it is to be a relied upon as a reference for the EIS.	KB	JR 11-17

Dissolved nitrogen and phosphorus versus total phosphorus and nitrogen. Plants use inorganic nutrients not particulate organic matter for growth. I have previously read the PESEP report *Nutrients and Phytoplankton in Puget Sound* prepared by Rensel Associates and PTI Environmental Services and I am aware of the arguments made in the section entitled **Review of Existing Nutrient Monitoring Protocols.**

The reasons for not including particulate and dissolved nitrogen in calculating nutrient availability to phytoplankton are many. We are interested in the nutrients available to primary producers in the inlet. Those are dissolved nutrients – not particulate nutrients. Particulate forms of N and P include living phytoplankton and zooplankton. The phytoplankton may be consumed by shellfish or finfish and sequestered (shellfish) or moved out of the inlet by migrating fish. Particulate N and P also include suspended detritus and the bacteria that attacks it (seen as marine snow). Detritus comes in many forms, some of which are labile (animal waste) and some of which are more refractory (eelgrass, some macroalgae, terrigenous particulates, etc.) An undetermined proportion of the particulate N and P that Rensel refers to eventually settles to the bottom where it is consumed by detritivores, bacteria or buried in sediments. Most of the organic loading accumulating in Totten Inlet sediments was at one time a part of the seston. Other portions of the particulate N and P pool may eventually be catabolized and returned to the water column in a dissolved form (DIN or PO_4 that is available for phytoplankton and/or macroalgae uptake) or in may be released to the atmosphere as N_2. The cycle times may be days, weeks, months or years. The point is that cell division times in Totten Inlet are short when primary productivity is not light limited and it is the nutrient availability during those one or two days that is important – not the potential nutrients available in living phytoplankton, zooplankton or detritus.

Nearly all research involving phytoplankton dynamics that I am aware of assesses DIN and phosphate along with other nutrients. In closing, the report clearly states that Totten Inlet appears to be a net consumer of dissolved nutrients.

Information describing tides. The evaluation of nutrients, POM and plant pigments began in 2002 with water samples collected on flood or ebb tides. An ongoing analysis of that data suggested that Totten Inlet was not a significant consumer of either. In light of this, preliminary sampling three hours before and after slack tide was conducted on July 10, 2002. Those results further supported a hypothesis that Totten Inlet was not near its carrying capacity. In addition, it became evident during this period that PSI was not going to analyze the data collected at Deepwater Point and write reports. It also became increasingly obvious that South Totten and North Totten behave very differently and that data collected at Windy Point by the Department of Ecology was inadequate to describe either area of the inlet. For these reasons and to provide more data describing water quality in North Totten Inlet, the canister studies and water column assessment was continued in 2003 at the site of the proposed mussel farm. The question that evolved during these studies was whether or not Totten Inlet was a significant consumer of nutrients, POM or living phytoplankton. If it was, that would suggest that further study to determine its carrying capacity might be warranted. These additional studies were undertaken in 2005. The report states at page 3 that samples were collected three hours before and after slack tide. While I agree with Jack Rensel, that there is a potential to sample the same water twice, the six hours provided between collecting the first set of samples and the second set was deemed necessary to minimize (but not eliminate) this potential. This procedure was considered less confounding than collecting samples on flood and ebb tides on different days – as was done in 2002. The bottom line is that the database includes samples collected on different days (2002) during flood and ebb tides and six hours apart on the same day (2005). Both exercises give similar results suggesting that Totten Inlet was not a significant consumer of nutrients, POM or plant pigments. Specific to Jack Rensel's request for more detailed tide information, Table 1 of the report has been modified to include tidal exchange data for each sampling period. In 2003, Taylor Shellfish collected the water samples, but failed to note the stage of the tide or the time when the samples were collected. Therefore, those samples were not included in the analysis because the tidal stage was unknown.

Degree of refluxed water. As noted above, I agree that this is potentially a confounding factor. The ebb and flood samples were separated by six hours to mitigate this issue. The results of the work conducted in Totten Inlet between 2002 and 2005 indicate that North and South Totten Inlets are somewhat isolated. This has significant influence on developing an overall flushing time for the inlet. If Totten Inlet were shown to be near its carrying capacity for shellfish, then determining a water residence time in the inlet might become important. However, there is no evidence that Totten Inlet is near its carrying capacity with estimates of 10 to 11% of carrying capacity when the proposed mussel farm is in production developed independently by Brooks and NewFields. Developing an understanding of circulation patterns and carbon flow in the inlet is a far more complex than recognized by the ITR and their proposed array of ADCP instruments across the inlet would have accomplished little in terms of modeling circulation or carbon flow. Experience with other models that have taken years to reach partial development indicate that wind plays an important role in defining circulation patterns and the proposal made by the ITR would not address this issue at all. Bottom line is that I agree with Jack Rensel that reflux may have influenced these results to some degree. However, the drifter card study of Lott (1998) is informative in this respect in that it shows that about 60% of the cards were retrieved outside Totten inlet and only 17.4% were retrieved within the inlet (see Figure 14 of Brooks, 2006). The few drifter studies conducted in 2005 are consistent with the Lott study in showing that once water leaves Totten Inlet on ebb tides, it is rapidly dispersed into other areas of South Puget Sound.

Error in defining the relationship between Chlα and phytoplankton biomass. Jack Rensel is correct in noting this error. He is also correct in noting that the relationship varies between species. In retrospect, I should have used equation 6 of Brooks (2006) developed by Hubbard (1987) rather than 50:1 *Chlα*:Carbon value. The text and Figure 21 were corrected to reflect that carbon is the endpoint being derived and not dry weight of phytoplankton.

Labeling of tables and figures. In response to Jack Rensel's observation that the population of water quality samples should be clearly identified in tables and figures, they have been re-labeled to reflect whether they were from the "mouth of North Totten Inlet" or "all North Totten sites." Figure 1 was also re-labeled for easier reading.

It is unclear why there is confusion about Figures 2 and 3. Figure 2 is for salinity and Figure 3 for temperature, which is clearly stated. The units (PSU, ^{o}C, and meters (m)) were provided in the text and/or on the graphs. Units have been added to the legend for Figure 3.

Quality of the YSI 33 meter. I called Yellow Springs Instruments to request information in this regard and their response was that, "Yes they do have to be maintained and yes they do have to be calibrated. However, we have never had any indication that they were "notoriously inaccurate, or that they performed unsatisfactory" Yellow Springs Instrument sold approximately 7,000 of the YSI Model 33 meters between 1973 and 1993 (Tom Moeggenberg, YSI, personal communication). I purchased my YSI 33 in the mid 1980's and have carefully maintained it over the years (including replatinizing the probe) with no indication that it gives erroneous readings. There are many standards and ways of calibrating salinometers. The use of synthetic sea salt (Crystal Sea Marine Mix in this case) is acceptable for low levels of precision. As Jack Rensel notes, the method may not detect small differences (e.g. 0.1 PSU or less).

However, that was not our intent and it would have been superfluous to use very precise standards to calibrate an analog instrument that can only be read to ~0.1 PSU. YSI 33 meters were used at UW when I was there and they were in use at Peninsula College when I became director of the Fisheries Technology Program. We also used them routinely at the Battelle MSL.

I have responded elsewhere to the use of Sigma-T to measure density rather than temperature and salinity. From my point of view, that procedure masks the forces (primarily temperature and salinity) that encourage stratification. This is particularly relevant in Totten Inlet where freshwater inputs are low from small watersheds and where thermal stratification in summer is more likely to cause stratification.

Nutrient Limitation Misinterpretation. In general, we are talking about nutrient limitation of primary production by phytoplankton. We are not talking about specific species. The 1 μM limitation is not in general "incorrect" as asserted by Jack Rensel. It only becomes incorrect when one starts talking about specific species of phytoplankton and that was not within the scope of this paper. Lastly, these investigations were made to **supplement** the NewFields analysis conducted in the absence of the expected PSI reports. There is nothing in Jack Rensel's comments requiring a change to this supplemental report.

Redfield Ratio Misunderstanding. This error was found and corrected in 2006. It is uncertain why Jack Rensel did not receive the final draft of the document. The information was corrected two years ago.

Phosphorus. I looked (using the Find function) for 1.92 mg/L and it could not be found in the entire document and I've been unable to determine what Jack Rensel is referring to. At the end of this section, he notes that, "Overall, if Figure 16 is correct, it appears that nitrogen is potentially limiting on all occasions but one (August 2, 2002), a radically different interpretation than what is given in the report." Figure 16 is a plot of the observed Redfield ratios. Jack Rensel's conclusion is inconsistent with the Chlα data showing that obviously phytoplankton were present in Totten Inlet at times during these studies (see Figure 9) . His error stems from the fact that low values of the Redfield ratio may be low because nitrogen is low and limiting or they may be low because phosphorus is high. That was not explored in this supplementary water column study.

Separation of growing and non-growing season. The purpose of the 2005 studies was to assess differences in nutrients, chlα and TVS in incoming and outgoing water. That was done during the late summer and fall bloom. The Chlα data provided in Figure 23 gives no indication of differentiated '"growing season" versus "non-growing season." Excepting the last sample period, chlorophyll concentration were >5 μg/L throughout the period.

Drifter Study. These studies were undertaken to assess the connectivity of North Totten Inlet with South Totten Inlet and to aid in understanding the potential for reflux in association with the mouth of Totten Inlet water quality studies. Drogues were released near the mouth of Totten Inlet (Figures 29 and 31) to determine the path of water originating in North Totten Inlet. Shallow drifter (1.5 m depth) were carried toward Windy Point on the flood tide and they then turned and exited the inlet going north or east – depending on the day. The point being that they moved well away from Totten Inlet on even partial tidal excursions. Drifters released near the Deepwater Point reference station on a significant tidal exchange (-12.5' to low slack and +13.6' to the following high). These drifters moved north, but did not move out of the inlet or even into the northern portions of Totten Inlet. These results suggest that once outside the mouth of Totten Inlet, drifters will be rapidly carried through Squaxin Passage or into Hamersley Inlet. These results also show that even on a significant tidal exchange, water from areas near Deepwater Point, did not leave the inlet. The drifter studies don't provide a definitive model of circulation in Totten Inlet. However, they do show how complex currents are; how quickly and far water leaving Totten Inlet is dispersed; and they reinforce the hypothesis that North and South Totten Inlet behave differently with respect to their flushing. The intended purpose of the study was served. Information regarding MHW and MLW was included on the inset tidal data charts. However, it was in 4 point print. The print was increased to 8 points and it is now easily readable with expanding the presentation on one's computer screen.

Phytoplankton production spreadsheet. The spreadsheet is full described in Brooks (2006) and its use is clear. The basic model was developed by Lott (1998) and in its modified form, it is considered useful as a tool for understanding the relationship between phytoplankton growth, solar insolation as a function of season, temperature and DIN. Perhaps the most important output is the turnover time in days of the phytoplankton population. This value can be compared with water residence time to help understand the importance of internal phytoplankton production within the inlet in comparison with the import of phytoplankton from areas outside the inlet. I agree that the hypothesis presented is only one of several that could be invoked and have indicated so in the text.

Estimating carrying capacity. The details supporting this analysis were provided in Brooks (2006). The reference to Appendix (1) should have been to Appendix (1) of Brooks (2006). There is no need to duplicate the work of others and the Edaw (1998) report is a part of this record.

Other comments.

Introduction with respect to the 2005 data. The previous data was reviewed and that resulted in development of the hypothesis. As stated, the 2005 data was specifically collected to test that hypothesis.

Canister data. There is a comparison between British Columbia reference station canister data and Totten Inlet data used solely to illustrate how much higher TVS deposition is in Totten in comparison with B.C. reference areas. The text and Figure 8 make it clear that the inferential analyses were conducted using only the Totten Inlet data.

Brooks (2000) has been changed in the document to Brooks (2006) as has Gardiner been changed to 2007.

The significance of a difference depends on the value of α chosen. Jack Rensel is incorrect in noting that if two means are not statistically significantly different, then one is not higher than the other. That statement is only true within the context of the willingness to accept a Type I error. It is not uncommon in the peer reviewed literature to note that one mean is higher or lower than another, but that the differences were not significant.

Baseline Studies. Jack Rensel comments with respect to the Baseline Study document are addressed below.

Totten Inlet's role as a consumer or producer of nutrients and phytoplankton. The Baseline report described the results of sampling through 2003. This document was completed in early 2005. I agree that the data regarding the import or export of nutrients and phytoplankton associated with Totten Inlet was weak. That is why the 2005 studies were developed and undertaken as an outgrowth of the Baseline report. As such, the 2005 studies were presented as a stand-alone document.

Current speeds. The maximum current speed of 84.3 cm/sec may seem unlikely. However, it was a part of the EHI database and as seen in Figure 30, numerous recordings of current speeds in the 65 to 75 cm/sec were included in the data. The histogram (Figure 27) clearly describes the distribution of values in the database and the summary of current speeds as a function of depth provided in Table 18 further describes the data. Mitsuhiro Kawase's visual guesses at the current speeds are not supported by the data, which is fully described therein.

Summarization of the studies. This work was initiated in the unfinished risk assessment document. However, Taylor Shellfish (Diane Cooper and Gordon King) decided that this task was best undertaken by the EIS writer (Vicki Morris). I stopped work on that document with their decision.

Use quantitative measures (sigma T density) to characterize vertical stratification in Totten Inlet, not anecdotal descriptions, use these data in the analysis of D.O. effects.	NF, KB	JR 14 RN 2-3

The data describing salinity and temperature as a function of depth is not anecdotal information. It is quantitative and has been displayed in the same format as presented by Evans Hamilton (see Figures 28 through 38 of Appendix A to the Evans-Hamilton Current Study). The reader is also referred to Figure 5 of Rensel *et al.* (undated) where temperature and salinity data are presented in an identical manner, with no discussion of Sigma-T.

Rensel, J.E., D.A. Kiefer, J.R.M. Forster, D.L. Woodruff and N.R. Evans (In-Press) Offshore finfish mariculture in the Strait of Juan de Fuca. U.S.-Japan Cooperative Program in Natural Resources, 33rd Annual Proceedings. Nagasaki, Japan 2004.

There is little or no indication in the salinity and temperature data of significant stratification in North Totten Inlet. Libes (1992) provides a chart of Sigma-T values as a function of temperature and salinity on page 670 (Appendix IX) for conversion purposes.

Libes, S.M. 1992. An Introduction to Marine Biogeohemistry. John Wiley & Sons, Inc. New York, New York. 734 pp.

I have no quantitative information describing the relationship between sediment redox potential and dissolved oxygen in the overlying water column. What I can say is that at potential salmon farm sites in Clayoquot Sound, British Columbia, I have observed very low dissolved oxygen in bottom water associated with an intrusion of upwelled Pacific Ocean water. These observations resulted in abandonment of efforts to develop the sites. However, the sediments had low TVS, low free sulfide and positive redox. Additional anecdotal evidence of little effect on the water column associated with low sediment redox potentials is found in the observation that *Beggiatoa* mats exist between aerobic and anaerobic conditions and that these are most frequently seen lying on the surface of anaerobic sediments. In addition, I have recorded many instances in which fish, crabs and prawns are seen feeding on *Beggiatoa* mats or on low chroma anaerobic sediments. Obviously there was sufficient oxygen in the water immediately over these sediments to provide for these animals needs. My sense is that in well circulated waterbodies (such as North Totten Inlet), the residence time of water over anaerobic sediments is too short to affect dissolved oxygen concentrations in the overlying water. All of the estimates of flushing times for Totten Inlet are relatively short suggesting (from a qualitative point of view) that there is little potential for low sediment redox potentials to affect dissolved oxygen in the overlying water. These thoughts cannot be applied to environments where the water is highly stratified and has very long residence times. If Jack Rensel or Roger Newell has peer reviewed documentation indicating otherwise, that information should be presented for consideration by NewFields Northwest.

Correct misinformation on *Metridium senile*.	NF, KB	RN 5 JR 9-10

I have not investigated the feeding habits of *Metridium senile* for this project.

Remove personal opinion from risk analysis.	KB	RN 11

The risk analysis has been removed from this report.

Briefly discuss what sulfide measurement techniques were used, provide citation for protocols, methodology and source or modifications. Discuss if partial omission of some of the particulate fraction of sulfide in sediments is an insurmountable problem. Discuss if other measurements that were collected are suitable benchmarks for detecting sediment eutrophication. Resolve contradictory statements as noted on page 18 of RN review.	KB	RN 15 RN 18

Sulfide and redox protocols. Protocols for field measurement of both free sulfides and redox potential are provided in detail on pages 9 and 10 of the document titled *Benthic response at the Deepwater Point mussel farm in Totten Inlet, Puget Sound, Washington State, U.S.A* and in

Brooks (2000, 2001a, 2001b) and Brooks and Mahnken (2003). They are based on the probe manufacturer's recommendations as modified by the author and published in the peer reviewed literature. While it seems irrelevant to the EIS, the peer reviewed and published report of Brooks and Mahnken (2003) will be referenced in the document.

Brooks, K.M. 2000. Sediment concentrations of sulfides and total volatile solids near salmon farms in British Columbia, Canada, during the period June through August, 2000 and recommendations for additional sampling. Prepared for the British Columbia Ministry of Environment and the British Columbia Salmon Farmers' Association. 16 pp.

Brooks, K.M. 2001a. An evaluation of the relationship between salmon farm biomass, organic inputs to sediments, physicochemical changes associated with those inputs and the infaunal response – with emphasis on total sediment sulfides, total volatile solids, and oxidation-reduction potential as surrogate endpoints for biological monitoring – Final Report. Technical report produced for the Technical Advisory Group (TAG) to the British Columbia Ministry of Environment, 2080-A Labieux Road, Nanaimo, British Columbia, Canada V9T 6J9. 186 pp. plus appendices.

Brooks, K.M. 2001b. Recommendations to the British Columbia Farmed Salmon Waste Management Technical Advisory Group for Biological and Physicochemical Performance Standards Applicable to Marine Netpens. Technical report produced for the Technical Advisory Group of the British Columbia Ministry of Environment, 2080-A Labieux Road, Nanaimo, British Columbia, Canada V9T 6J9. 24 pp.

Brooks, K.M. and C.V.W. Mahnken. 2003. Interactions of Atlantic Salmon in the Pacific Northwest Environment. II. Organic Wastes. Fisheries Research, Vol. 62, Issue 3, pp. 255 – 293.

Acid Volatile Sulfides (AVS) and Chromium Reducible Sulfides (CRS). Roger Newell deferred to J.C. Cornwell with respect to sediment geochemistry. Dr. Cornwell provides an interesting discussion regarding the potential for using AVS to assess the long-term effects of benthic enrichment associated with intensive aquaculture. The usefulness of AVS in understanding the bioavailability of metals such as copper is well documented. See the references below for information regarding sulfide, copper and zinc remediation at fallow salmon farms.

Brooks, K.M. and C.V.W. Mahnken. 2003. Interactions of Atlantic salmon in the Pacific Northwest Environment. III. Accumulation of zinc and copper. Fisheries Research, Vol. 62, Issue 3, pp. 295-305.

Brooks, K.M., A.R. Stierns, C.V.W. Mahnken and D.B. Blackburn. 2003. Chemical and biological remediation of the benthos near Atlantic salmon farms. Aquaculture, Volume 219, Issues 1-4, pp. 355-377.

Brooks, K.M. , A.R. Stierns and C. Backman. 2004. Seven year remediation study at the Carrie Bay Atlantic salmon (*Salmo salar*) farm in the Broughton Archipelago, British Columbia, Canada. Aquaculture. Aquaculture 239, pp. 81-123.

This is an interesting area of investigation and one that may evolve in the future as informative for the management of aquaculture. However, as he notes, it is an emerging area of interest and I am unaware of its use in any jurisdiction other than apparently in Japan. Other researchers have proposed using phosphorus or lithium normalized metal concentrations as indicators of sediment remediation. Questions that would have to be answered before using AVS would include:

a. Determination of the rate constants for transformation of iron sulfide (FeS) and pyrite (FeS_2) under a variety of sediment redox, sediment grain size and dissolved oxygen concentrations in the benthic boundary layer is needed. AVS associated with acidification to pH <3 does not analyze for the pyrite fraction that requires evaluation by CRS. Does pyrite degrade?
b. Given that we know the rate constants, what fraction of the sulfur liberated from FeS is oxidized to sulfate (non-toxic) or to hydrogen sulfide which is toxic and what are their residence times in remediating sediments? This is necessary to understand whether or not remediation to baseline concentrations of iron sulfide has any biological significance.
c. The real issue is whether or not there is a biological response to iron sulfide or pyrite and/or their oxidation products. If there is not, then it is not a meaningful endpoint for assessing the environmental costs associated with organic enrichment.

In discussing the *Baseline* document, Dr. Cornwell expresses reservations regarding the use of the sulfide probes and their lack of sensitivity to particulate sulfur. Free sediment sulfides have been recognized as a useful tool for understanding the macrobenthic response to enrichment since at least the mid 1990's when Barry Hargrave, Dave Wildish and I began using them. Sediment free sulfides now form the basis for numerous regulatory programs designed to manage the effects of intensive aquaculture around the world.

Physicochemical surrogates for assessing biological responses to enrichment in Totten Inlet. The baseline report includes an extensive database describing sulfides, redox potential, TVS, TOC and Sediment Grain Size (SGS). This suite of endpoints (absent TOC) is commonly used in many jurisdictions for assessing the environmental response to intensive aquaculture. The sediment physicochemical data for Totten Inlet is consistent with the macrobenthic community. Brooks (2001) provides an extensive database relating the response of individual taxa and communities of invertebrates to free sediment sulfides. While TVS is not an appropriate indicator for the reasons given in the peer reviewed literature and redox potential is difficult to measure and interpret, these surrogates are considered useful for validating the sulfide data. The point being that the suite of physicochemical endpoints evaluated in Totten Inlet are those that are frequently used in similar studies and in this case they have provided a useful and internally consistent picture of existing benthic conditions in the inlet.

Perceived contradictions. Roger Newell perceives a contradiction in the abstract of the baseline report with respect to the qualitative statements regarding sediment sulfide concentrations. For clarification, the statement that "Free sulfides were moderately low . . ." applies to the centerline of Totten Inlet (see Figure 7 of the report) where free sulfides were moderately elevated, but generally <250 µM. Highest concentrations were ca. 450 µM observed on the inlet's centerline north of the proposed mussel farm site. The second statement that "sediments were organically enriched with high total organic carbon and sulfide concentrations" applies to the area of the proposed farm where sulfide concentrations in the southern portions of the surveyed area reached values as high as 1,240 µM. The abstract refers to two different areas and therefore the statements would apply differently. Having given this comment careful consideration, I have decided to leave the wording as is. It is important to emphasize that sediments in throughout most of Totten Inlet are enriched and that sediments south of the farm are significantly enriched. The exception being the scour pit inside the sill at the mouth of the inlet.

Further discuss conclusion that sediments in Totten Inlet are already near to their assimilative capacity and how that may quantitatively relate to low bottom water D.O.	KB	RN 17

No evidence of problematically low dissolved oxygen concentrations in bottom water were observed in North Totten Inlet during these studies (see Figure 7 of the Baseline document). North Totten Inlet appears well flushed and NewFields Northwest reports minimum DO concentrations of 5.9 mg/L at 10 to 20 meters depth. Minimum concentrations further south in the inlet were 5.65 mg/L at the maximum depth sampled. To the best of my knowledge there is no information describing DO in the benthic boundary layer, which is likely only a few cm thick in the southern sections of the inlet. The Inlet is shallow with little evidence of significant stratification suggesting reasonable mixing and a reduced potential for low dissolved oxygen in bottom water. The drifter studies reported in the Baseline document suggest some limitation to water exchange between North and South Totten Inlet, which may influence dissolved oxygen concentrations there – at least in the benthic boundary layer. However, large portions of the southernmost portions of the inlet are exposed on low tides, further mitigating this factor. The bottom line is that there is no evidence of problematically low DO in Totten Inlet and the BOD associated with existing sediment TVS concentrations as reflected in the moderately low redox potentials is not expected to significantly influence the water column (based on the author's experience at salmon farms).

Complete genetics paper through editing, corrections and respond to substantive comments.	KB	RE

The comments of Ralph Elston were helpful and most were incorporated in a revised document. The two missing citations identified by Roger Newell were also added to the document.

Discuss implications of use of smaller than optimum drogues.	KB	MK 1

The drogues used in this study have four (60 cm x 60 cm) panels that together with their supporting framework giving a sail area of 1.8 m^2. This is stated in the introduction to section 3.4 of the report *Baseline information describing sediment physicochemistry of Totten Inlet and the macrobenthos of the proposed North Totten Inlet mussel farm*, which states, "Three window shade drifters were constructed of PVC pipe and fiber reinforced PVC sheeting. Each of the four orthogonal panels comprising each drifter measured 60 cm by 60 cm." Excepting that the panels are attached to rigid PVC frames, the sail area and configuration are similar to that described by Davis (1985), who used this design to determine currents at depths to 30 meters in an area described as having high winds. The same design is currently being used by the Canadian Department of Fisheries and Oceans for Broughton Archipelago drifter studies. The point being that the design is well documented in the peer reviewed literature and drifters having this sail area are frequently used in coastal studies.

Davis, R.E. 1985. Drifter Observations of Coastal Surface Currents During CODE: The Method and Descriptive View. J. Geophysical Res. 90(C3), 4741-4755.

Address comments in Executive Summary regarding interpretation of drogue, current meter and flushing rates.	KB	MK1

Based on Kawase's comment, I have added a statement with detailing the upper and lower 95th percentile current speeds in the data (3.9 and 32.4 cm/sec). These statements are simply a summary of what was actually measured. The dispersion of waste is not just a function of current speeds and direction at the specific point of release (the mussel farm). The purpose of the drifter studies at the proposed farm site was to evaluate the transport of seston leaving the farm in an effort to better understand the expected deposition patterns.

Mitsuhiro Kawase references the Evans Hamilton ADCP data. He concludes that "the maximum speed of the current (admittedly from visual inspection) is about 20 cm/s, occasionally touching 25 cm/s;" The Evans Hamilton data is described quantitatively in section 4.6 of the Baseline document. The maximum current speeds of 50.43 to 84.32 cm/sec were recorded at all depths and that 9,155 of the 54,024 ADP recordings of speed and direction were $\geq$ 25 cm/sec (17%). The **mean current speed** recorded by EH in the top meter of water was 36 cm/sec and this **mean** speed was greater than 14.94 cm/sec at all depths (Table 18 on page 61 of the Baseline document) – confirming that this site is very well flushed. Table 18 is copied from the report. The discussions in Sections 3.4 and 4.6 of the baseline document accurately reflect the data.

Table 18. Mean, minimum and maximum current speeds observed as a function of water depth at the site of the proposed North Totten Inlet mussel farm. Raw data collected over a one month period using an Acoustic Doppler Current Profiler (EHI, 2006).

Breakdown Table of Descriptive Statistics (North Totten Current Speeds)
N=54024 (No missing data in dep. var. list)

Depth code (m)	Current Speed (cm/sec) Means	Current Speed (cm/sec) Sum	Current Speed (cm/sec) Minimum	Current Speed (cm/sec) Maximum	N
1	36.12	1481	5.920	61.71	41
2	19.52	23458	0.760	71.81	1202
3	17.87	45027	0.280	74.12	2519
4	17.17	62332	0.200	84.32	3631
5	16.57	70540	0.000	75.15	4256
6	16.34	75552	0.100	59.58	4623
7	16.21	76507	0.140	53.85	4719
8	16.34	77102	0.100	58.50	4719
9	16.23	76608	0.140	53.05	4719
10	16.23	76583	0.000	51.58	4719
11	16.13	76123	0.280	55.72	4719
12	15.95	75283	0.000	50.43	4719
13	15.71	74118	0.360	52.60	4719
14	14.94	70483	0.100	57.41	4719
All Grps	16.31	881196	0.000	84.32	54024

There were two basic reasons for conducting the drifter studies. As stated above, the first reason was to assess the drift of particulate organic matter released from the farm as it settles to the bottom. Visual observations coupled with the sediment, POM and chlα data in 2002 and 2003 suggested that the northern and southern areas of Totten Inlet behave somewhat independently from each other. The second purpose of the drifter studies was to asses the movement of water on spring and neap tides to test this hypothesis of independence and to achieve some understanding of how refluxed water might influence the same tide water samples collected just south of the mouth of Totten Inlet.

Response to other comments by Roger Newell. Originally, Taylor Shellfish planned on using information generated by the Pacific Shellfish Institute in completing their Sea Grant funded studies. Unfortunately, Sea Grant lost its funding and the second year and third years of these studies were cancelled. The Pacific Shellfish Institute did not write reports evaluating the data collected in their first year of study. This left Taylor Shellfish without the expected water column information needed to address the EIS. NewFields Northwest was retained to synthesize the PSI data and provide the needed input. Aquatic Environmental Sciences participated in the PSI grant with tasks to develop a method for measuring nutrients in bottom water and to evaluate the epibenthic community growing on the mussel rafts. Those reports were written and submitted to PSI. However, to the best of my knowledge, they are the only reports completed on that first year's work. This is the reason for the lack of citations that Roger Newell refers to.

With respect to the bottom nutrient work, the first year's effort was dedicated to developing and testing the method for measuring nutrients as a function of height above the sediments. Additional work was planned for the second year. However, as noted above, the second year of the PSI project was not funded. The initial evaluation of the methodology did allow us to measure differences in nutrients in the water column as a function of height above the sediments and distance from the netpens and that information has been provided. It is consistent with other reports indicating that nutrient reflux from enriched sediments to the water column is a localized effect. The results are considered informative with respect to understanding the spatial distribution of near bottom nutrient enrichment associated with intensive shellfish culture.

The *Supplemental study of dissolved nutrients and particulate organic matter in the waters near the proposed mussel farm in North Totten Inlet, Washington State, USA* was undertaken in recognition of the apparent differences between North and South Totten Inlets and the lack of water quality data specific to North Totten Inlet. As the title states, this report was considered *Supplemental* to the NewFields' report and it was not intended to replace that report.

Feeding efficiency of mussels. Roger Newell criticized NewFields section on the feeding efficiency of mussels. This was discussed in more detail in section 4.6 of Brooks (2006) including specific references to peer reviewed literature. That review found that mussel feeding efficiency varies significantly depending on the density of particles in seston. The literature reports values 10% (Tenore *et al.* (1973) to 40 to 60% (Bayne, 1976).

Brooks, K.M. 2006. Literature review and model evaluation describing the environmental effects and carrying capacity associated with the intensive culture of mussels (*Mytilus edulis galloprovincialis*). Aquatic Environmental Sciences, 644 Old Eaglemount Road, Port Townsend, WA 98368.

Sincerely,

Dr. Kenneth M. Brooks
Aquatic Environmental Sciences