EXHIBIT
A-60

Millennium Coal Export Terminal
Longview, Washington

Coal Export Terminal including Docks 2 and 3 and Associated Trestle

Addendum to the Biological Assessment for NOAA Fisheries Species

May 30, 2017

Prepared by:

Grette Associates, LLC
151 South Worthen Street, Suite 101
Wenatchee, Washington 98801
509-663-6300

Prepared for:

Millennium Bulk Terminals – Longview, LLC
ATTN. Kristin Gaines
P.O. Box 2098
Longview, WA
360-425-2800

1. VESSEL WAKE STRANDING

1.1 Introduction

Wakes produced by deep-draft vessels have been shown to strand juvenile salmon at some locations in the lower Columbia River (Bauersfeld 1977, Hinton and Emmett 1994, Ackerman 2002, Pearson et al. 2006). Field studies at select sites have confirmed that wake stranding represents a complex and episodic process related to a multitude of interdependent factors, including shoreline morphology, a ship's kinetic energy, tidal height, and the seasonal presence of small fish in shallow water habitat.

Barlow Point, which is located approximately 1.2 miles downriver from Millennium Bulk Terminals-Longview's ("MBT-Longview's") proposed Coal Export Terminal ("CET"), stands out as having a combination of localized morphologic and hydraulic conditions that make it highly susceptible to fish stranding in comparison to other beaches on the lower Columbia River. Under current conditions, deep-draft vessels transiting past Barlow Point operate at speeds similar to other unrestricted sections of the river (9 to 15 knots). Once the proposed terminal is operational, vessels passing the CET will slow down to avoid damaging the new dock or vessels berthed therein. Because slower speeds result in a lower potential for wake energy to result in stranding, and deep draft vessels require ample distance to change their speed (on the order of miles), MBT-Longview's proposed CET terminal operations are expected to:

1. Lead to little or no additional fish stranding at Barlow Point by vessels calling at the CET,
2. Reduce or eliminate stranding at Barlow Point by all ~3,800 vessel transits passing this area annually.

Although vessels calling at the CET would produce wakes that are capable of stranding fish, it is expected that the benefits of reduced stranding from the ~3,800 vessel transits will either offset or exceed the stranding impact of the Project.

Previous studies demonstrate that not all juvenile salmonids are susceptible to stranding. Most stranding events include small subyearling Chinook salmon that are utilizing the shallow river margins. The subyearling Chinook salmon that are subject to stranding are primarily from the Lower Columbia River ESU. Subyearling Columbia River chum and Lower Columbia River coho salmon also utilize the shallow nearshore margins of the river and have been stranded by ship wakes, but in very low numbers compared to subyearling Chinook salmon. Juvenile sockeye, yearling Chinook salmon, and yearling coho salmon and juvenile steelhead trout are not typically susceptible to stranding.

1.2 Factors Affecting Vessel Wake Stranding at Barlow Point

Barlow Point is one of the most studied standing sites on the Columbia River. Barlow Point stands out as an unusual case, even amongst other sites with known histories of stranding. Pearson et al. (2006) selected three beaches with known histories for stranding fish (County Line Park, Barlow Point and Sauvie Island). Of these three beaches, Barlow Point had the highest proportion of stranding events per vessel (53% of vessel passages led to a stranding event compared with 15% at County Line Park and 37% at Sauvie Island). Barlow Point also had the highest number of fish stranded per event (14.9 fish/stranding event at Barlow Point, vs 7.3 and 5.6 fish/stranding event at County Line Park and Sauvie Island, respectively – Table 1). In total, over 80% of all juvenile salmonids observed stranded in the Pearson et al. (2006) study were at Barlow Point. And within this site, one small 'hotspot' was the location of most of the stranding. An earlier study (Ackerman 2002) also found Barlow Point to have the highest stranding rate of any beach they observed.

Table 1. Vessel wake stranding at three known high risk beaches on the Lower Columbia River (from Pearson et al. 2006)

Site	Percentage of vessel passages resulting in stranding	Mean number of fish stranded per event
Barlow Point	53%	14.9
County Line Park	15%	7.3
Sauvie Island	37%	5.6

Researchers have identified several factors that make this beach so susceptible to stranding. Barlow Point is unique in that it has the lowest slope of any beach studied by either Ackerman (2002) or Pearson et al. (2006). At the time of Ackerman's field efforts, the average slope at the Barlow Point hotspot was 1.6%. Pearson et al. (2006) reports the average slope of Barlow Point to be just over 2%, but observed an area three and half times the size of Ackerman (2002). Gradual beach slope is recognized throughout the stranding literature as a prerequisite for stranding to occur (Bauersfeld 1977, Hinton and Emmett 1994, Ackerman 2002, Pearson et al. 2006, 2008, Pearson 2011).

The stranding hotspot at Barlow Point is also subject to a complex wave environment not typical of more uniform beaches. The upper slope of the Barlow Point hotspot is protected from erosion by a gabion structure referred to as "Reno Mat". The mat is wetted at high tide and redirects wave energy so that it travels laterally along the mat, generally in the downstream direction, towards the hotspot. It was at the location where these complex cross waves formed where stranding occurrence was the highest (Figure 1). Pearson et al. (2006) also noted this cross-wave effect at the two other beaches studied (Sauvie Island and County Line Park), though not to the same extent as at Barlow Point. Overall, fine-scale beach features (depressions, cross waves, vegetation, etc.) are recognized throughout the literature as affecting the stranding process (Bauersfeld 1977, Ackerman 2002, Pearson et al. 2006).

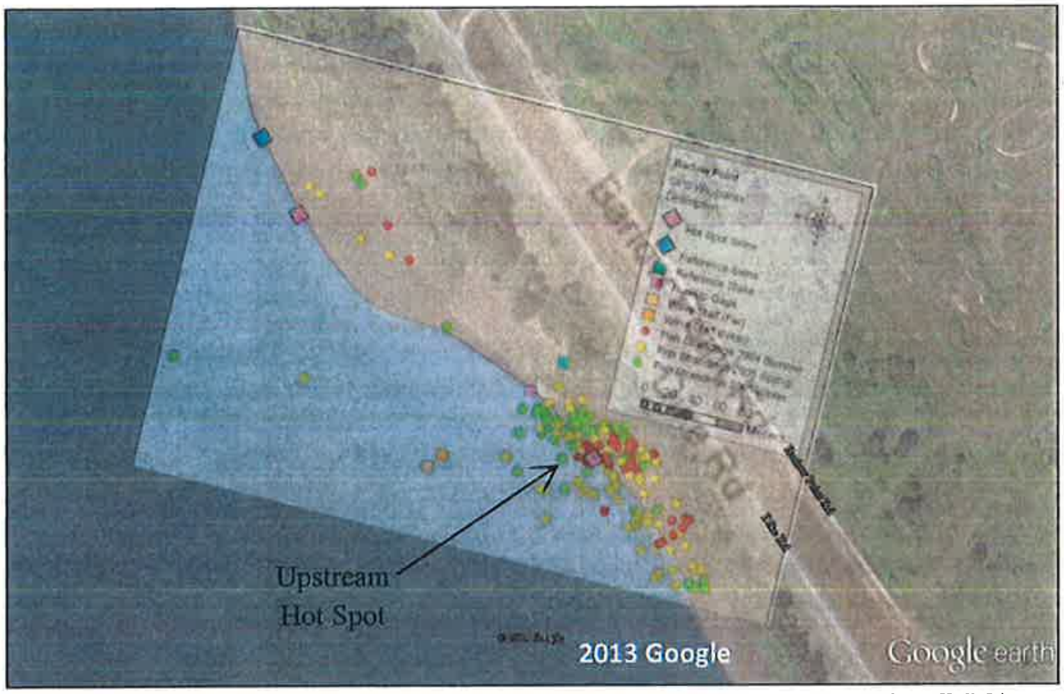

Figure 1. Overlay of the Barlow Point study site with stranding observations (for all fish) (graphic reprinted from Pearson et al. 2006; aerial photography from Google Earth 2013)

To better understand stranding patterns at Barlow Point, Coast and Harbor Engineering (2016) conducted an analysis of beach morphology at Barlow Point. That study concluded that the occurrence of a wide lower beach and narrow upper beach yielded a configuration that does not dissipate wave energy and likely contributes to stranding. Coast and Harbor Engineering (2016) also noted that the location of Barlow Point on the outside of a river bend also likely focuses energy to this site, increasing stranding risk.

It is clear that a unique combination of factors specific to Barlow Point (notably fine scale beach features), contribute to high incidences of stranding at the Barlow Point hotspot.

1.3 Vessel Speed and Wake Stranding

Modeling results from Pearson (2011) determined that all other factors being equal, stranding potential for large ships transiting through the navigation channel is influenced more by vessel speed than by vessel draft. Pearson et al. (2006) found that wave height and the resulting stranding impacts were a function of vessel size times speed squared. This demonstrates the dominant role ship speed plays in generating the types of waves that strand fish for a given vessel.

The results from Pearson et al. (2006) illustrate that at the three sampling locations, stranding events are more common at higher vessel speeds. In that study, although the sample size for slow moving vessels was small, vessel wake stranding was not observed at speeds below 9 knots. The percentage of vessels that stranded fish rose to 23% for ships traveling between 9 and 12 knots, and to 45% for vessels traveling greater than 12 knots (Pearson et al. 2006, Table 2). This trend was also observed at Barlow Point considered along.

Table 2. Vessel speed as it relates to the occurrence of vessel wake stranding (based on results from Pearson et al. 2006).

Vessel Speed	% of Vessels passages that resulted in stranding	Number of ships observed	Number of stranding events observed
All Three Sites[1]			
6-9 knots	0%	1	0
9-12 knots	23%	52	12
>12 knots	45%	67	30
All Speeds Combined	37%	126[2]	46
Barlow Point Only			
6-9 knots	0%	1	0
9-12 knots	39%	23	9
>12 knots	65%	23	15
All speeds combined	53%	49[3]	26

[1] Sauvie Island, Barlow Point, and County Line Park.
[2] Speed data was not recorded for six of the vessels, and they are not represented in the results broken out by speed.
[3] Speed data was not recorded for two of the vessels, and they are not represented in the results broken out by speed.

1.4 Wake Stranding Impacts from Vessels Calling at the CET

At full build-out (Stage 2 operations), up to 70 cargo vessels per month (840 per year) could be loaded at the CET (IFC International 2016). This translates to 1,680 vessel transits (one-way trips) per year. The vessels would consist of Panamax and Handymax bulk carrier vessels, two vessel classes that routinely operate in the lower Columbia River (Columbia River Pilots 2013). These vessels are capable of producing wakes that would contribute to fish stranding at locations downriver from the proposed CET.

Specifically, a few known and suspected fish stranding beaches are in the immediate vicinity of the CET facility. For example, the Barlow Point hotspot is 1.2 miles downstream of the downriver end of the proposed CET docks. Because large commercial vessels require ample distance to change their speed (typically on the order of miles), vessels calling at the CET would not be at full speed (9-15 knots) when passing Barlow Point. Specifically, vessels arriving at the CET docks would be slowing to prepare for docking. Once loaded, they would maneuver back to the navigation channel and would still be accelerating when passing Barlow Point. Such maneuvering would result in little risk of stranding near the proposed docks as very little wake energy is generated by vessels moving at slow speeds (IFC International 2016). This means that, Project-related vessels would be passing the Barlow Point hotspot at speeds below those known to strand fish. Therefore, it is concluded that vessels calling at the CET facility will not increase or otherwise contribute to the occurrence of fish stranding at Barlow Point.

This same operational effect may also benefit other potential stranding beaches located in the immediate vicinity of the Project Site. For example, Pearson et al. (2008) identified clusters of beaches susceptible to stranding and found the low gradient beaches along Lord and Walker Islands (on the Oregon bank between river mile 61 and 65[1]) as having characteristics consistent with elevated stranding risk (low beach slope, proximity to the navigation channel and shallow offshore berms – Pearson et al. 2008). These beaches are located just across the navigation channel from the Project Area (located at river mile 63). As with Barlow Point, vessels calling at the CET facility would be maneuvering at slow speeds when passing Lord and Walker Islands and would not cause fish stranding at these beaches. Further, there is a high degree of uncertainty about whether stranding actually occurs at these beaches[2].

Sites further downriver, would be more likely to have a higher risk of fish stranding from vessel wakes because vessels are transiting those areas at higher speeds (IFC International 2016). For example, vessel wake stranding is known to occur at County Line Park, located downstream of the CET, albeit at rates significantly less than at Barlow Point (Pearson et al. 2006 and Ackerman 2002). Stranding could also occur at other beaches farther downriver, such as those located opposite Puget Island between river mile 43 and 47 (Pearson et al. 2008), although there is uncertainty about the occurrence and extent of stranding at these beaches due to a lack of stranding data and information on fine scale beach features from these areas. Because the presence of fine-scale features such as coves, inlets, complex wave environments and vegetation are known contributors to the occurrence of stranding, there is a high degree of uncertainty about the appropriateness of applying stranding rates observed at known stranding beaches to these beaches.

1.5 Berth Occupancy at the MBT-Longview CET

Based on the planned operations of the CET, it anticipated that one or more of the berths will typically be occupied. During Stage 1 operations, it is anticipated a vessel will either be at the loading berth (Dock 2) or at the lay berth (Dock 3) essentially at all times. This conclusion is based on the transit plans of deep draft vessels crossing the Columbia River Bar and the time it takes to handle and load the vessel at the dock (T. Simmons, MBT-Longview, pers. comm. 2017).

Vessel departures are planned to ensure that loaded vessels arrive at the Columbia River bar during a "window of opportunity" when they will have sufficient under keel clearance during one of the periods of daily high tide. This constraint in conjunction with the fact that it takes 1-2 hours to dock and prepare an inbound vessel for loading, followed by 15-16 hours of loading and 1-2 hours to prepare for departure and leave the dock means that even during Stage 1 operations, the occupancy rate at or near Dock 2 (which will have a shiploader) will be very high. During

[1] See *Table 13 – Clusters of Transects with Non-Minimal Susceptibility* in Pearson et al. (2008) for a full list of sites.

[2] Note: The Pearson et al. (2008) study was a GIS based analysis that did not contain any new field work. There have been no follow up studies to verify whether fish stranding is occurring at the beaches identified as having elevated susceptibility to stranding. Because this study did not consider fine-scale habitat features, a known contributor to stranding, there is a high degree of uncertainty about its accuracy. Accordingly, attempting to linearly extrapolate the rate of stranding throughout the lower Columbia River based on this study is not scientifically supported.

Stage 1, Dock 3 (which will not have a shiploader) will be used as a lay berth for vessels waiting to load or depart. Given that 40 vessel calls are planned per month during Stage 1, there will be a vessel at either Dock 2 or Dock 3 a very high percentage of the time. During Stage 2 operations, when shiploaders are present on docks 2 and 3, both berths will typically be occupied. With 70 vessel calls per month at least one berth will always be occupied during Stage 2 operations.

1.6 Project Impacts on Existing Vessel Wake Stranding at Barlow Point

All large commercial vessel traffic bound for Longview or ports further upriver pass the Project Area. Bar Pilots records for the period from 2004 to 2014 report deep draft vessel transits (one-way trips) in the Columbia River ranging from between 2,926 and 3,858 annually (Jordan pers. comm. 2014, as cited in IFC International 2016). AIS data provided by the Merchants Exchange of Portland, Oregon reported a slightly higher number, with 3,862 vessel transits in 2014[3]. Under current conditions, deep-draft vessels transiting past the CET Project Area operate at speeds similar to those in other unrestricted sections of the river (approximately 9 to 15 knots - DNV GL 2016). This range of speeds is consistent with vessel speeds observed by Pearson et al. (2006) at Barlow Point (Figure 2).

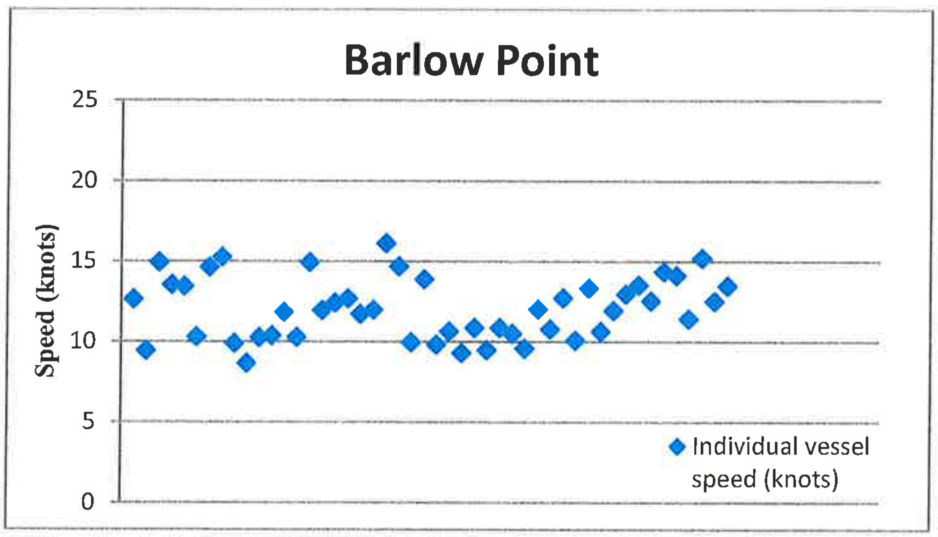

Figure 2. Over ground speed of vessels passing Barlow Point (data from Pearson et al. 2006).

All deep draft vessels transiting past the CET facility will be slowing to reduce their wake out of the necessity to avoid damaging the new docks or berthed vessels. This is because the same hydrodynamic forces that create the wakes that strand fish also exert forces on berthed vessels and the docks where they are berthed. Like wake stranding, the magnitude of force exerted is a function of the passing vessels size, distance and speed.

[3] The variance is a result of different recording methods and vessel type designations of the data sources. The Bar Pilots data are generally equivalent to bar crossings, (i.e., entries and exists from the river system) and may not reflect in-river vessel movements.

With the CET Project, the size of the passing vessels will remain unchanged from the existing condition. To reduce their wake effects when passing the CET facility, the River Pilots will be slowing and in some cases, moving to the Oregon side of the channel (R. Gill, COLRIP, pers. comm. 2017). Based on their size, deep draft vessels require sufficient distance (typically on the order of miles) to alter their speed. Due to the proximity of Barlow Point to the CET facility, vessels passing that beach will either be slowing to pass the facility or in the process of accelerating to continue downstream. As Barlow Point and the CET facility are both located on the Washington side of the channel, efforts by the River Pilots to move the vessels further away from the CET docks will also lessen shoreline wake effects at Barlow Point.

Based on the site-specific conditions at the CET facility, passing deep draft vessels will be slowing to speeds of approximately 8 knots to avoid damaging the new docks or vessels berthed there (R. Gill, COLRIP, pers. comm. 2017). As discussed above, wake stranding was not observed at speeds below 9 knots (Pearson et al. 2006). Based on this, it is concluded that the proposed facility will have the effect of slowing all vessel traffic transiting past Barlow Point, greatly reducing or eliminating the occurrence of fish stranding at this beach. This will have the greatest effect on the Lower Columbia River ESU of Chinook salmon. Subyearling Columbia River chum and Lower Columbia River coho would also benefit, but to a lesser degree. This would also be the case at the beaches on Lord and Walker Islands, two other suspected stranding sites.

1.7 CONCLUSION

Vessel wake stranding is known to be a highly complex and episodic process, requiring a multitude of interdependent factors. That being said, most shorelines in the lower Columbia River do not pose a stranding risk. Although one study did attempt to characterize lower Columbia River shorelines at a landscape scale according to their stranding risk (Pearson et al. 2008), that effort did not incorporate fine-scale beach features[4]. Because the presence of fine-scale features such as coves, inlets, complex wave environments and vegetation are known contributors to the occurrence of stranding, there is a high degree of uncertainty about the appropriateness of applying stranding rates observed at known stranding beaches to this broader area.

In contrast, three beaches (Sauvie Island, Barlow Point and County Line Park) have been the focus of intensive fish stranding studies (Ackerman 2002 and Pearson et al. 2006) and there is a high degree of certainty about the fish stranding process at these beaches. Sauvie Island is located upriver from the Project and vessels calling at the CET will not pass or strand fish at this beach. Although existing studies show that vessels calling at the CET will likely increase stranding at County Line Park, the Projects benefits on fish standing at Barlow Point will offset or exceed these impacts as summarized below:

[4] Note: The Pearson et al. (2008) study was a GIS based analysis that did not contain any new field work. There have been no follow up studies to verify whether fish stranding is occurring at the beaches identified as having elevated susceptibility to stranding. Because this study did not consider fine-scale habitat features, a known contributor to stranding, there is a high degree of uncertainty about its accuracy. Accordingly, attempting to linearly extrapolate the rate of stranding throughout the lower Columbia River based on this study is not scientifically supported.

- Two lower Columbia River studies found the hotspot at Barlow Point to have the highest occurrence of fish stranding of any beach they observed (Ackerman 2002 and Pearson et al. 2006).
- In 2014, there were over 3,800 one-way vessel transits past Barlow Point.
- Pearson et al. (2006) found that during the juvenile salmonid outmigration period, 53% of passing vessels led to a stranding event at Barlow Point. On average, approximately 15 fish were stranded per event at this beach. The incidence and degree of fish stranding at Barlow Point was higher than either of the other two beaches (Sauvie Island and County Line Park) included in that study.
- Pearson et al. (2006) found that wake stranding events were more common at higher vessel speeds.
- Deep-draft vessels transiting past Barlow Point currently operate at speeds of between 9 and 15 knots.
- When vessels are berthed at the new CET docks, all passing deep-draft vessels will slow to avoid damaging the new docks or the vessels berthed therein (R. Gill, COLRIP, pers. comm. 2017).
- Based on the CET's planned operations, one or more of the berths will typically be occupied during Stage 1 operations. During stage 2 operations, when shiploaders are present on docks 2 and 3, at least one of the berths will be occupied at all times.
- Barlow Point is located approximately 1.2 miles downriver from the proposed CET docks.
- Based on the distance required for large vessels to change their speeds (typically on the order of miles) it is concluded that the CET Project will have the effect of slowing all deep-draft vessels transiting past Barlow Point to a degree where fish stranding will be greatly reduced or otherwise eliminated at this beach.
- Most stranding events include small subyearling Chinook salmon that are utilizing the shallow river margins. Reducing the occurrence of vessel wake stranding at Barlow Point will have the greatest benefit for the Lower Columbia River ESU of Chinook salmon. Subyearling Columbia River chum and Lower Columbia River coho would also benefit, but to a lesser degree.

Based on an extensive review of the wake stranding studies that have been conducted in the lower Columbia River, and an understanding of operations at the proposed CET facility, it is concluded that the continued presence of the vessels at the site will greatly reduce or eliminate the occurrence of vessel wake stranding at Barlow Point. This will reduce the number of fish stranded by the baseline ~3,800 one-way vessel transits passing Barlow Point annually. This benefit at Barlow Point is expected to offset or exceed fish stranding impacts farther downstream from vessels calling at the CET.

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