BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of: Application No. 2013-01 TESORO SAVAGE, LLC TESORO SAVAGE DISTRIBUTION TERMINAL	CASE NO. 15-001 SWORN PRE-FILED TESTIMONY OF GLENN GRETTE

I, Glenn Grette, state as follows:

1. I declare under the penalty of perjury of the laws of Washington and the United States that the following statements are true and correct.

2. I am over eighteen years of age, have personal knowledge of the matters herein, and am competent to testify regarding all matters set forth herein.

I. INTRODUCTION, EDUCATION AND PROFESSIONAL BACKGROUND, OTHER QUALIFICATIONS, AND PURPOSE OF TESTIMONY

3. My name is Glenn Grette and I am a principal and Senior Biologist with Grette Associates. My business address is 151 South Worthen Street, Suite 101, Wenatchee, Washington 98801. My land line phone number is 509-663-6300 and my email is glenng@gretteassocites.com.

4. I have a B.S. in Zoology from Washington State University that was conferred in 1981 and an M.S. in Fisheries from the University of Washington that was conferred in 1985. My Master of Science Thesis dealt with rearing habitat of juvenile salmonids.

5. I have over 30 years of experience in permitting major development projects and contaminated sediment cleanup actions. These projects typically have impacts on fish and primarily juvenile salmonids. I have evaluated the impacts and

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developed mitigation actions for major shipping terminals, marina expansions, and dredging projects. A major part of my work is aiding clients in complying with the Endangered Species Act (ESA). I am currently supporting Millennium Bulk Terminals with their proposed Coal Export Terminal and their existing Bulk Products Terminal. My other experience on the Lower Columbia River includes work for the Port of Longview on reconfiguring Berth 4 and supporting the Lower Columbia River Ports on aspects of the previous U.S. Army Corps of Engineers (USACE or Corps) channel deepening project. I have attached a resume to the end of this written testimony that further highlights my experience as Attachment A.

6. The purpose of my testimony is to provide testimony regarding potential wake impacts from project vessels, and specifically: 1) the Vancouver Energy Project's Application for Site Certification (ASC) compliance with WAC 463-62-040(2)(a), and WAC 463-60-332; and 2) the issues, including the Environmental Impacts Issues (Issues 5, 6, 8, 17, 18) and the Tribal Issues (Issues 38, 40-42, 56), as identified in the Administrative Law Judge's Order Clarifying EFSEC's Process, Modifying Dispositive Motion Deadline, Summarizing Preliminary Issues, and Setting Hearing Dates (Feb. 3, 2016). Specifically, my testimony provides an analysis of the effects of vessel wakes on fish and their habitat to supplement and clarifies and corrects errors contained in the portions of the Energy Facility Site Evaluation Council (EFSEC) Draft Environmental Impact Statement (DEIS) that addressed the impact of vessel wakes on fish.

II. SCOPE OF ANALYSIS OF THE TERMINAL'S IMPACTS

7. I first became involved with Applicant Tesoro Savage Petroleum Terminal LLC, d/b/a Vancouver Energy (hereinafter, TSPT or the Applicant) in December 2013. I assisted TSPT in developing comments on the EFSEC DEIS.

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8. I was asked to evaluate a number of issues related to the potential impacts of vessel wakes on fish, fish habitat, shoreline vegetation, and tribal resources. This work resulted in a detailed analysis of wake impacts, the analysis and conclusions of which are contained in a report, Grette 2016, attached hereto as Attachment C.

9. I was provided the applicant-prepared DEIS; the third-party-prepared EFSEC DEIS; the applicant-prepared Biological Assessment; and the comment package prepared by TSPT on the EFSEC DEIS. I collected a number of technical documents that are listed with references in Attachment B.

III. DATA RELIED UPON

10. I have conducted a review of previous studies on the effects of vessel wakes on aquatic species including a detailed analysis of the two key previous studies on the Lower Columbia River from its mouth to River Mile 104. I have conducted a detailed examination of the distribution of juvenile Chinook salmon that use the Lower Columbia River to determine those populations that are most likely to be exposed to the risk of stranding. In addition, I worked with Dr. Vladimir Shepsis on his study that examines the relationship between beach morphology and stranding at three of the most studied wake stranding sites on the Lower Columbia River. Finally, I developed opinions from my analysis on the likelihood that wake stranding from vessels calling at the facility would measurably influence the populations of adult salmon returning to the Columbia River.

11. I started my study by reviewing previous studies that addressed stranding in the Lower Columbia River. I have included a list of those studies as the first part of Attachment B.

12. I consider the five key finding of these studies to be:

- Not all juvenile fish are susceptible to stranding. The majority of fish stranded are small subyearling Chinook salmon.

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- Wake stranding is typically limited to the winter, spring, and early summer, when subyearling Chinook salmon are present in the shallow river margin.

- Stranding is a complex process related to many interdependent factors, including site location, a ship's size and speed, tide height, wave travel up the beach, and the abundance of fish in the shallow water margins.

- Most shorelines along the Columbia River do not strand subyearling Chinook salmon. Shorelines between River Miles 0 and 22 do not present a risk of stranding, and those between River Miles 22 and 25 have only minimal risk. Overall about 33 miles of shoreline or 16% of the shoreline has some potential to strand fish between River Miles 0 and 104.

- Fine-scale characteristic of the beach which causes waves to congregate, transport, and trap fish are important in determining the risk of stranding at a specific location.

13. I relied on extensive information, including field studies conducted to determine populations of aquatic species subject to stranding. Based on the results of the previous studies that small subyearling Chinook salmon were most susceptible to wake stranding, I more closely examined the populations of Chinook salmon that are subject to stranding along the Columbia River. To do this I looked at recent studies that incorporated DNA analysis to separate which Evolutionarily Significant Units (ESU) of Chinook salmon are present along the shoreline of the Lower Columbia River and could be susceptible to stranding. ESU is the term the National Marine Fisheries Service (NMFS) uses to describe the populations salmon in a region when considering impacts under the ESA. Individual ESUs can be listed as "Threatened" or as "Endangered" or as not warranted for listing under the ESA. There are eight ESUs of Chinook salmon recognized in the Lower Columbia River and five are listed as either Threatened or Endangered under the ESA.

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14. Roegner et al. (2012 and 2013) performed genetic-stock analyses to assign subyearling fish to populations and I used that information to assign fish to their ESU of origin and to determine the proportional presence of each ESU in the shallow water margins. I used those studies and other studies described in Attachment C to determine which Chinook salmon ESUs where typically present in the shallow water areas of Lower Columbia River.

III. ANALYSIS PERFORMED TO ASSESS THE EFFECTS OF VESSEL WAKES ON AQUATIC RESOURCES

A. Impacts of project-related vessels on aquatic species as to vessel wakes

15. I primarily evaluated the impact the vessels calling at the facility would have on wake stranding of juvenile fish. I also examined the potential for vessel wakes to cause impacts to fish habitat including shoreline vegetation.

16. Wake stranding is the process by which juvenile fish are captured or entrained within a rapidly moving wave that travels up a beach and then recedes rapidly depositing the fish on the dewatered beach causing severe stress, injury, or mortality. Large vessels traveling in a confined channel can cause wakes that strand juvenile fish. Stranding events in the Lower Columbia River typically involve large, deep-draft vessels such as container ships, bulk carriers, oil tankers, and vehicle carriers. A more detailed treatment of wake stranding is presented in the attached Attachment C.

i. Populations of Chinook salmon subject to stranding

17. In the lower part of the study area, from River Mile 33 to River Mile 74, fall-run Chinook salmon from the Lower Columbia River ESU make up generally greater than 90 percent of all Chinook salmon present in shallow water areas. This can be seen in Table 2 of Attachment C.

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18. In the upper part of the study area from River Mile 86 to River Mile 102, Chinook salmon from the Lower Columbia River ESU make at least half to more than three quarters of subyearling Chinook salmon in shallow water areas depending on the season. This can be seen in Table 3 of Attachment C. In the winter, subyearlings from the Upper Willamette River ESU are approximately one-third of the fish, with almost all of the remaining fish being fall-run Lower Columbia River Chinook salmon. In the summer and fall period, Upper Columbia summer/fall run ESU fish comprise approximately one-third of the fingerling population between River Miles 86 to 102. This greater proportion of Upper Columbia summer/fall run ESU fish in this area compared to reaches farther downstream, below River Mile 74, is likely due to their generally moving to deeper waters over the course of their outmigration, as is typical for subyearling Chinook salmon. Therefore, they are present near the shoreline in the reaches between River Miles 86 and 102 while relatively small but move away from the shoreline as they grow on their migration to reaches farther downstream.

19. In summary, subyearling Chinook salmon can occur within the tidal freshwater region year-round, but presence in the shallow margin is limited largely to the spring, with low relative abundance in the winter and summer. Based on genetic-stock analyses, the majority of subyearling Chinook salmon present in the shallow nearshore during all seasons originate from the Lower Columbia River ESU, and of those, the majority represent fall-run stocks.

ii. Risks of stranding eulachon

20. I also looked at the distribution of larval eulachon and concluded they were unlikely to be located in the shoreline habitat and susceptible to wake stranding. This is supported by the fact that eulachon were not observed either stranded or in beach seines conducted by Pearson et al. (2006). Assuming that some portion of adult eulachon spawn

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in the Columbia River mainstem, they are not likely to spawn in the shallow margin where fish are susceptible to stranding because this area is not typically characterized by moderate to fast moving water over coarse substrates. Therefore, one can infer a very low susceptibility to stranding risk. Further, adult eulachon are strong swimmers; any adult eulachon which may occur in the shallow margin (spawning or in transit) are unlikely to be entrained by onshore waves. Overall, adult eulachon do not appear to be at risk of wake stranding in the Lower Columbia River. I have included additional information on eulachon in Attachment C.

iii. Potential for vessel wakes to strand more fish species

21. My analysis indicates that few other species are at risk. During the Pearson et al. (2006) study, a total of 126 ship passages were observed at the three study sites (County Line Park, Barlow Point, and Sauvie Island), and 46 passages resulted in the stranding of 520 fish of all species. The majority (426 fish, 82 percent) of stranded fish were small subyearling (age-0+) Chinook salmon. A total of eight juvenile chum salmon and seven juvenile Coho salmon were stranded, for a combined total of 441 juvenile salmon or 85 percent of all fish.

22. Non-salmon comprised 15 percent of the observed stranded fish. These were dominated by three-spine stickleback (40 fish, 8 percent). The remaining species were each represented by fewer than 10 strandings (less than 2 percent of the total), listed in decreasing rank: peamouth chub (9), mountain whitefish (8), banded killifish (7), bass (fry) (5), American shad (4), yellow perch (2), sunfish/bluegill (1), crappie (1), starry flounder (1), and unidentified salmonid (1).

23. Although yearling (age-1+) Chinook salmon, juvenile steelhead, and sculpin were detected in beach seines nets at the study sites in very low numbers, they were not observed in stranding events.

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24. Overall, subyearling (age-0+) Chinook salmon are the species that are most often stranded by vessel wakes. That species and life stage was also the most common fish captured in beach seine nets at the study sites, indicating they were highly available to be stranded. The next most stranded species, three-spine stickleback, was stranded about one tenth as often as were subyearling Chinook salmon.

iv. Stranding in the Lower Columbia River

25. Stranding occurs at specific points along the Lower Columbia River rather than along the whole length of the river. Studies have been conducted at specific locations where stranding is known to occur including County Line Park, Barlow Point, and Sauvie Island. To further refine the potential areas where stranding may occur, Pearson et al. (2008) examined the characteristics of the Columbia River shoreline from River Mile 0 to River Mile 104 by measuring along transects overlain on bathymetric data and aerial photographs. The transects were spaced 200 meters apart yielding a total of 1634 transects. Based on the analysis the majority of the shorelines in the Lower Columbia River were concluded to not pose a stranding risk to subyearling Chinook salmon (Pearson et al. (2008)). Further, they concluded that between River Miles 0 and 22, shorelines were too far distant from the Columbia River channel for wake energy to pose a stranding risk.

26. Pearson et al. (2008) determined that 16 percent (269 transects) of the transects met the criteria of being close enough to the shoreline and not shielded from vessel wakes to have the energy necessary to cause stranding and had a beach slope flatter than 10 percent. These 269 transects define a set of non-contiguous beaches that total 33 miles of shoreline, that was predicted to have at least some potential to strand fish when vessel wakes interacted with the shoreline. The conclusion that these beaches have a risk of stranding is very conservative and more likely to predict stranding occurs when it does

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not occur than vice versa, due to the inclusion of the 10 percent slope criterion. Pearson et al. (2006) did not study any sites that had this "steep" of a beach. County Line Park had a slope of about 4 percent, Barlow Point had a slope of about 2.2 percent and Sauvie Island had a slope of about 2.5 percent. Pearson et al. (2008) presents information from previous studies showing that fish are more typically stranded on beaches with slopes flatter than about 5 or 6 percent and not all of the very flat beaches strand fish. Therefore, I conclude that the 33 miles of shorelines identified above includes many beaches that have very limited to no stranding risk due to the inclusion of the very conservative 10 percent criterion.

27. When Pearson et al. (2008) considered all of their criteria but only considered transects with shallow underwater berms and very flat slopes (<2.5 percent), 4 percent of the total transects (65 transects) had the highest predicted potential susceptibility for stranding. Four percent of the 208 miles of shoreline studied means that approximately 8 miles of shoreline were predicted to have a high susceptibility to stranding based on including the two more criteria.

28. I have summarized the findings of Pearson et al. (2008) in a figure as Attachment D. This figure is more precise than a generalized figure that was included in the applicants comments on the DEIS. The new figure includes all transects that were determined to have above minimal risk of stranding and the most extreme risk of stranding as predicted by Pearson et al. (2008). The original figure was meant to illustrate the general distribution of possible stranding sites in the lower 106 miles of the Columbia River, instead of showing all of the distinct transects included in the Pearson et al. (2008) analysis.

29. Pearson et al. (2006) noted that much of the stranding at Barlow Point occurred in an area where strong cross-waves and an eddy formed when the waves ran up

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the beach. Other researchers, such as Hinton and Emmett 1994 and Bauersfeld 1977, noted the importance of fine-scale beach features, such as coves, inlets, and shoreline depressions, in redirecting wave energy to congregate, transport, and trap fish. Collectively these observations suggest that the approximately eight miles of beaches identified as having high susceptibility to stranding as identified by Pearson et al. (2008) likely need to have such fine-scale features for the predicted high occurrence of stranding to actually occur. Pearson et al. (2008) used video available from other researchers to examine what fine-scale features, specifically looking for rip-rap, gabions, and piers, were present near their study transects. They did not draw conclusions about what was seen or use the observations to develop another criteria to further refine their predictions of stranding susceptibility for the transects studied.

v. Influence of fine-scale beach features

30. It is important to consider fine-scale beach morphology because based on the results of the stranding studies, particularly at Barlow Point, we know that even at a site that has characteristics that based on Pearson et al. (2008) suggest a high susceptibility to stranding over much of the site, actual stranding only occurs in a subset of the site in "hotspots." Stranding at hotspots is best illustrated at Barlow Point, in contrast to the wider distribution of stranding events at County Line Park and Sauvie Island. This can be seen by comparing figures in Attachment C that show these sites. The majority of stranding events at Barlow Point were clustered at a very small upstream hot spot. The magnitude of stranding at Barlow Point suggests that something more complex and unique is happening there than at either the Sauvie Island or County Line Park study sites. To a lesser extent, stranding events at Sauvie Island and County Line Park were associated with hot spots, but stranding at these sites were grouped more according to season, based on the results of Pearson et al. (2006). This is likely due to differences in water levels during

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different times of the year altering the location of the water's edge and also modifying beach morphology. At all the sites the hotspot stranding patterns occurred despite the generally even distribution of fish across these sites as determined by beach seine net sampling during the Pearson et al. (2008) study. This means that stranding susceptibility on a single beach can vary greatly over a very short distance and is likely associated with the fine-scale features of the beach.

31. Hotspot stranding is also important because it affects the conclusions of studies, such as Pearson et al. (2006), that have derived relationships between physical parameters, such as beach slope and stranding. Such studies and the relationships derived from them are based on stranding observations dominated by the hotspot at the Barlow Point study site.

32. Coast and Harbor (2016) conducted a focused review of the morphology at the precise locations where stranding occurred at the Barlow Point, County Line Park, and Sauvie Island study sites to further evaluate how site morphology and the resulting hydraulics relate to the patterns of stranding that were observed by Pearson et al. (2006). Coast and Harbor (2016) found that beaches with a wide upper beach and a small and/or steeply sloped lower beach had a low potential for fish stranding due to the dissipation of wake energy. Shorelines with a wide and flat lower beach with no or very small upper beach and typically with an armored backshore, do not have a mechanism for dissipating wake energy. As a result, this type of shoreline morphology has a higher potential for stranding fish. County Line Park at River Mile 51.5, and Sauvie Island at River Mile 96.5, both represent morphologies with a lower potential for stranding, compared to Barlow Point, while the morphology of Barlow Point is associated with a very high risk of stranding (Coast and Harbor (2016)).

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33. In addition to overall beach morphology as described above, Coast and Harbor (2016) identifies that the location of the Barlow Point stranding hotspot on an outside bend of the river likely further contributes to the stranding at this site. Essentially, the hotspot is located at a focused point for energy based on how the ships turn offshore. This configuration focuses wave energy, likely increasing the effect of the vessel wakes.

34. The beach characteristics that Coast and Harbor (2016) identified as contributing to high stranding risk are additional criteria that can be applied to refine the understanding of areas that strand fish. The results of that study help explain why stranding does occurs at some locations that would appear to have the potential for stranding based on the criteria of Pearson et al. (2008).

IV. METHODOLOGY AND IMPACTS

35. I analyzed wake stranding by considering what is known about populations of Chinook salmon that are present in the shallow water margins of the Columbia River and considering the specifics of the studies addressing wake stranding including Pearson et al. (2006) and Pearson et al. (2008). I also drew on the results of Coast and Harbor (2016). In addition, I have considered the time in the life history of Chinook salmon when they are subject to wake stranding.

A. Conclusions from analysis

36. Vessel wakes can and do strand small subyearling Chinook salmon from the Lower Columbia River and Upper Willamette River ESUs in the vessel corridor thereby contributing to mortality early in their life cycle. Not every wake strands fish nor does every beach have the physical characteristics that strand fish. Although the magnitude of mortality caused by stranding is not fully understood, the information known about stranding risk and subyearling Chinook salmon life history and habitat use is

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useful for predicting the gross scale of the potential impacts on Chinook salmon populations.

37. The following points summarize what we know about vessel wake stranding risk in the Lower Columbia River:

- Wake stranding occurs on a small subset of non-contiguous shorelines in the vessel corridor, not over a broad length of shoreline.
- Stranding typically occurs at "hotspots" rather than across the whole length of a beach. Fine-scale morphological features, that control wave effects at the shoreline, appear to be necessary for there to be a stranding "hotspot" on a beach.
- Pearson et al. (2008) did not include fine-scale beach features as a criterion in evaluated the stranding risk at a particular beach. Coast and Harbor's (2016) study indicates that additional morphological features are likely necessary for a beach to have a high risk of stranding.
- Overall, stranding "hotspots" could be very limited to small subset of beaches with numerous special physical characteristics.
- Stranding is episodic and happens when a number of factors co-occur when fish are present.
- The seasonal abundance of small Chinook salmon in shallow shoreline habitat varies as does the numbers of fish stranded (Pearson et al. (2006)).
- Vessel wake behavior on the beaches is highly variable based on the characteristics of the vessel and its speed (Pearson et al. (2006)).
- Stranding hotspots are determined by the morphological characteristics of the beach, not by the aggregation of the fish to a specific stranding-susceptible location or the quality of the fish habitat. This conclusion is based on the results of Pearson et al. (2006) where subyearling chinook were typically stranded at the "hotspot" even though sampling with a net showed the fish were distributed along all portions of the study site.

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- Subyearling Chinook salmon present in the shallow water margins of the Columbia River are on a "rearing migration" continually moving downstream rather than holding in one location for months. This means that an individual fish is subject to stranding risk intermittently, not continually, on its path to the ocean. This distribution means the mortality contributed by wake stranding to a specific fish population is much less than if individual fish hold for extended periods in high stranding risk habitat.

38. Overall, existing information points to wake stranding being a focused and episodic contributor to mortality. Furthermore, wake stranding affects a life stage that is experiencing natural and typically high mortality at this point in the life history. After passing the potential stranding beaches, subyearling Chinook salmon will enter the estuary. I am defining the estuary narrowly here as below River Mile 34, where many other factors, such as fish and bird predation and competition with other species will contribute to mortality. Finally, they enter the ocean where natural mortality rates are very high. For example, 1 to 2 percent of outmigrants making it to the ocean might survive to adulthood. Due to the natural high rate of mortality experienced by Chinook salmon after they pass the portions of the Columbia River where stranding occurs, it is not clear that stranding actually has a measureable effect on the total number of adult Chinook salmon returning to the river. All factors point to a relatively small impact on the population of returning adults to the Lower Columbia River ESU and an even smaller impact to the Willamette River ESU.

39. As ESA-listed salmon, Lower Columbia River and Upper Willamette River Chinook salmon are under the jurisdiction of NMFS. NMFS has evaluated the impacts of wake stranding on the Lower Columbia River ESU and the Upper Willamette River ESU in a number of ESA consultations supporting federal actions for a number of projects involving navigation including:

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- 2002 Biological Opinion for the Columbia River Channel Improvements Project (NMFS 2002).
- 2005 Biological Opinion for the Columbia River Channel Improvements Project (NMFS 2005a).
- Biological Opinion for the Port of Kalama North Port Marine Terminal Expansion Project (NMFS 2005b).
- Biological Opinion for the Port of Longview Berth 9 Grain Terminal Facility Project (NMFS 2006).Biological Opinion for the Kinder Morgan Berth Deepenings at Linnton and Willbridge Terminals (NMFS 2010a).
- Biological Opinion for the Port of Kalama United Harvest Pier Modernization Project (NMFS 2010b).
- Biological Opinion for the Columbia Pacific Bio-Refinery Barge Dock Expansion (NMFS 2015).

40. In each case, NMFS concluded that wake stranding contributes to early life mortality for these ESUs but that federal approval of each of the projects "would not jeopardize the continued existence" of ESA-listed species, including these two ESUs. The federal permitting process for the Vancouver Energy Project will include analysis of these types of impacts on ESA-listed species and NMFS will draw its conclusions about the impacts of the project on ESA-listed salmon. Of the 25 different factors identified by NMFS as limiting the recovery of salmon populations in the Columbia River estuary, defined broadly as downstream of River Mile 146, wake stranding is considered a primary contributor to a low-priority factor (NMFS 2011).

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B. Impacts of project-related vessels on erosion and vegetation

i. Conditions of the banks of the Lower Columbia River relative to erosion from vessel wakes

a. Methodology for determining impact of wake on shoreline

41. I reviewed information on vessel wakes from a previous EIS and I examined how the authors of the DEIS conducted their analysis. The Current DEIS analysis was conducted by assuming that the conclusions of wake stranding studies could be used to approximate the impacts to shoreline erosion and vegetation and fish habitat. I demonstrate that that approach was flawed in subsequent testimony.

b. Analysis of wake impact on shoreline erosion and vegetation

42. The Corps' Channel Deepening EIS (USACE 1999) reported that the natural shorelines of the Lower Columbia River (encompassing the vessel corridor for the DEIS) have remained very stable over the past 100 years, consisting largely of erosion-resistant sand, silt, and clay deposits (USACE 1999). Approximately half of the shoreline between River Miles 21 and 106 are dredge disposal sites which are not natural shorelines and are highly susceptible to erosion (USACE 1999). Many of the dredge disposal sites are sandy habitats that are frequently disturbed by sand placement (USACE 2016). The disposal sites are subject to wakes, currents, and continual wind waves (USACE 1999).

43. Additionally, the entire vessel corridor is currently exposed to vessel wakes from the ships that use the river. The vessels that would call at the Facility terminal are within the size range of current vessels and would be piloted at similar speeds. Therefore, the wakes from these vessels would be similar to current wakes. This means the shorelines, which have little susceptibility to erosion, would be subject to an incremental increase in vessel wakes that are not currently causing erosion. It is correct to conclude

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that there will be more vessel wakes, but there is no basis for concluding there will be erosion impacts in the estuary (lower 33-34 miles of the river) from these wakes that would affect complex habitats. This is because as describe previously in my testimony in the lower 33 miles of the river, the bank are distant from the navigation channel and the waves do not interact with the beach the same way they do within the more confined channel upstream of that point. In addition, impacts upstream to River Mile 106 are not expected based on description of the river banks presented in the Corps' Channel Deepening EIS (Corps 1999).

C. <u>Impacts of project-related vessels on tribal and cultural resources</u>

44. Based on my analysis, the lower Columbia Chinook salmon and upper Willamette Chinook salmon ESUs have the greatest potential to be affected by wake stranding. But the populations of these ESUs are not likely to be significantly affected by wake stranding. All other fish have a very low risk of being affected by wake stranding. The treaty tribes fish above Bonneville dam and depend on the fish produced above the dam. The Lower Columbia River and upper Willamette River ESUs are located below Bonneville Dam. Based on the separation of these populations from the fishery I conclude wake stranding will not affect the availability of fish for treaty tribes.

D. <u>Assessment of DEIS analysis and Washington Department of Fish and Wildlife comments</u>

45. I reviewed the DEIS and the comment letter from Washington Department of Fish and Wildlife dated January 21, 2016. In addition, I examined a number of studies as previously described in my testimony.

i. Lower 33 miles

a. <u>Issues with the methodology or the approach to the analysis in the DEIS</u>

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46. The DEIS is incorrect to conclude that stranding occurs *in the lower 33-mile portion (16 percent) of the Columbia River*. The authors of the DEIS did not correctly interpret the results of Pearson et al. (2008). Pearson et al. (2008) was a GIS-based analysis of the physical characteristics of the Columbia River shoreline intended to determine the portions of the river that presented a risk of stranding of fish when a vessel wake interacted with the shoreline. This study built on the results of Pearson et al. (2006), which identified shoreline characteristics that were associated with stranding risk. A key conclusion of Pearson et al. (2008) was:

> The results of this study clearly indicate that physically-based susceptibility to stranding of juvenile salmonids by ship wakes is limited to a portion of the [Lower Columbia River]—approximately 16% (~33 miles) of the [Lower Columbia River] shorelines with beaches close to the channel, not shielded from wave action, and with beach slopes less [than] 10%.

47. The 33-miles of shoreline referenced by Pearson et al. (2008) is the sum of the area of numerous non-connected beaches that the authors concluded exhibited physical characteristics predicted to have an above-minimal risk of stranding Attachment D. Pearson el al. 2008 does not conclude that stranding is limited to the "lower 33-mile portion of the Columbia River" instead it concludes that there is a total of 33 miles of non-contiguous beaches with above minimal risk of stranding within the area they defined as the "Lower Columbia River."

48. Pearson et al. (2008) defined the "Lower Columbia River" on page 29 of their report to begin at the mouth River Mile 0 and extend to Vancouver, Washington River Mile 104, which corresponded to the upstream and downstream extents of their study area and encompasses essentially the entire "Vessel Corridor" for the DEIS. Attachment D shows the location of the areas identified by Pearson et al. (2008) that have

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characteristics concluded to have an above-minimal risk of stranding. These areas occur from River Mile 22 to River Mile 104 and there is no contiguous 33-mile reach of the "lower river" where the shoreline characteristics indicate a susceptibility to stranding.

49. The errors in the DEIS as to the area of stranding risk are clearly demonstrated by the absence of locations with stranding risk between River Miles 0 and 22. Pearson et al. (2008) found that shorelines downstream of River Mile 22 were too far distant from the navigation channel for vessel wakes to pose a stranding risk. Further, few areas were identified with an above-minimal risk of stranding between River Miles 22 and 33, as seen in Attachment D. Therefore, the lower 33 miles of Columbia River, contrary to the DEIS discussion, is an area of very low potential for fish stranding from vessel wakes rather than an area of high stranding.

50. As I stated, the DEIS erroneously concluded that stranding occurred in the *lower 33-mile portion of the Columbia River*. Pearson et al.'s (2008) 33 mile total of beaches along the shoreline of the "Lower Columbia River" includes beaches on both the Washington and Oregon sides of the river. Therefore, the 104 river miles from River Mile 0 to River Mile 104 from Pearson et al. (2008), contains 208 miles of shoreline. The DEIS conclusion of moderate to high stranding risk was based on an assumptions that 66 miles of shoreline, 33 miles on each side of the lower 33 miles of the river, were subject to stranding. So in addition to identifying the wrong location in the river, the DEIS considered too much shoreline length as having even a minimal potential to strand fish.

51. In addition to identifying the 33 miles of shoreline that had an above minimal risk of stranding, Pearson et al. (2008) further refined their criteria to identify the subset of shoreline that had the highest risk of stranding as defined by their parameters. Of the 33 miles of shoreline reaches with above-minimal risk of stranding, only about 8 miles, or about 4 percent of the 208-mile study area, was predicted to have the highest

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stranding risk as defined by Pearson et al. (2008). All the beaches in this 8 mile total are located upstream of River Mile 33. These results indicate that stranding risk is relatively high only in a very small portion of the 208 miles of shoreline in the Vessel Corridor and all these beaches are upstream of the lower 33 miles of the Columbia River.

b. DEIS conclusion about the magnitude of the impact of stranding on fish

52. The DEIS draws the conclusion that stranding leads to "moderate to major long-term effect on nearshore fish including listed salmonids and eulachon species in the lower 33-mile portion (16 percent) of the Columbia River."

53. The DEIS's broad conclusions about stranding are flawed because:

- The DEIS identifies the wrong area of the Lower Columbia River as having beaches that are likely to strand fish. Stranding does not occur in the "lower 33 miles of the Columbia River." There is no contiguous 33-mile reach of the "lower river" where the shoreline characteristics indicate a susceptibility to stranding (Figure 1).
- Stranding primarily affects one species, Chinook salmon, not the broader categories of "nearshore fish" or "salmon."
- Eulachon appear to be at limited risk of stranding by vessel wakes based on the analysis provide above, and were not detected in the most intensive stranding study that has been conducted (Pearson et al. (2006)).
- Further with respect to stranding of Chinook salmon, only small, 35mm to 80mm, fish of one age group, 0+ subyearlings, is at risk of stranding and only when present in shallow water.
- The subyearling Chinook salmon that are produced above Bonneville Dam are typically larger than 80 mm when they reach the Vessel Corridor and are not expected to be close to shore and susceptible to risk of the stranding.
- Subyearling Chinook from the Upper Willamette River ESU could be of a size that they are subject to stranding when they exit the Willamette River and reach the Vessel Corridor. However, they are

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distributed close to shore only in the upper portions of the Vessel Corridor and in much lower numbers than the Lower Columbia River ESU.

- The subyearling Chinook salmon that are subject to stranding are primarily from one ESU, (Lower Columbia River). Subyearling Chinook salmon from the Upper Willamette River ESU are at a lower risk of stranding because they are present close to shore in much lower numbers and along a much shorter portion of the Vessel Corridor.

54. Stranding by vessel wakes is not a risk to the general fish community, it is a risk for two discrete components of the fish community. However, Chinook salmon area highly valued in the Pacific Northwest and the ESUs described above are listed as "threatened" under the ESA.

55. Existing ship traffic in the Vessel Corridor yields some wakes that cause mortality of small subyearling Chinook salmon (Pearson et al. (2006)). Vessel traffic in the Columbia River is less than it was at its peak in the recent past. Ship calls to the proposed facility or increases in calls to existing facilities could contribute to additional mortality compared to that occurring at todays reduced level of vessel traffic. Ship calls to the Columbia River could increase or decrease without the Project up to or beyond the historical peak. This means the impacts of the no-action alternative could be less than, equal to, or greater than the impacts from Facility related vessels due to economic factors that drive ship calls to the Columbia River. For this reason, the impact of wake stranding is most accurately addressed from the perspective of cumulative impacts, not project specific impacts.

c. <u>DEIS conclusion on shoreline erosion and impacts to vegetation and fish habitat including essential fish habitat</u>

56. The entire analysis of the impacts of vessel wakes on shoreline erosion and vegetation is flawed due to the characterization of a key reference document on fish

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stranding. The DEIS is incorrect in focusing on stranding impacts in an erroneous contiguous lower 33-mile portion of the Columbia River. Further, it was incorrect to extrapolate from the erroneous stranding conclusions for the lower 33 miles of the river to evaluate the potential for impacts to other shoreline resources like vegetation, wetlands, and other complex habitats including fish habitat. The conclusion of Pearson et al. (2008) is that wave energy from vessel wakes seldom reaches the shoreline in the lower 33 miles of the river. Therefore, there is no rationale to conclude vessel wakes strand fish or that vessel wakes can cause other effects in the "lower 33-mile portion of the Columbia River." In fact vessel wakes should have their least impact in this area.

57. Further, the DEIS indicates that effects would be greatest within the Columbia River estuary, apparently indicating a subset of the lower approximately 33 miles. This is a confusing statement, as the DEIS defines the estuary as the reach of the river below River Mile 34. DEIS § 3.3.2.3. Thus, the "lower approximately 33-mile reach" and the "estuary" are defined as essentially the same section of river. Further, as discussed above, there is no basis for concluding that the estuary is susceptible to erosion from vessel wakes.

58. The DEIS assumes that the shoreline is susceptible to erosion from vessel wakes but it does not provide any information to demonstrate there is a risk of it occurring. The information presented above in the cited comments demonstrates that the lower 33 miles of the river has very limited exposure to vessel wakes. The Corps' Channel Deepening EIS (USACE 1999) reported that the natural shorelines of the Lower Columbia River (encompassing the vessel corridor for the DEIS) have remained very stable over the past 100 years, consisting largely of erosion-resistant sand, silt, and clay deposits (USACE 1999). Approximately half of the shoreline between River Miles 21 and 106 consists of dredge disposal sites which are not natural shorelines and are highly

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susceptible to erosion (USACE 1999). Many of the dredge disposal sites are sandy habitats that are frequently disturbed by sand placement (USACE 2016). The disposal sites are subject to wakes, currents, and continual wind waves (USACE 1999).

59. Additionally, the entire vessel corridor is currently exposed to vessel wakes from the ships that use the river. The vessels that would call at the Facility terminal are within the size range of current vessels and would be piloted at similar speeds. Therefore, the wakes from these vessels would be similar to current wakes. This means the shorelines, which have little susceptibility to erosion, would be subject to an incremental increase in vessel wakes that are not currently causing erosion. It is correct to conclude that there will be more vessel wakes, but there is no basis for concluding there will be erosion impacts in the estuary (lower 33-34 miles of the river) from these wakes that would affect complex habitats. Further, impacts upstream to River Mile 106 are not expected based on description of the river banks presented in the Corps' Channel Deepening EIS (Corps 1999).

ii. Conclusion

60. The conclusions presented in the DEIS about impacts related to vessel wakes are flawed and inappropriate because they are based on the erroneous assumption that vessel wakes are likely to have impacts in the lower 33 miles of the Columbia River, a stretch of the river that has complex habitats and high levels and diversity of fish use. The impacts related to vessel wakes are consistently and substantially overstated due to this error.

61. The degree to which the error permeated the impacts conclusions of the DEIS is demonstrated by a number of quotes I have include in Attachment E.

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iii. Cumulative impacts

62. The cumulative impacts conclusions from the DEIS related to vessel wakes are flawed for the same reasons that the impact section were flawed as described previously in my testimony. Specifically, the erroneous assumption that vessel wakes are likely to have impacts in the lower 33 miles of the Columbia River the river that has complex habitats and high levels and diversity of fish use. The cumulative impacts related to vessel wakes are consistently and substantially overstated due to this error.

63. The degree to which the error permeated the cumulative impacts conclusions of the DEIS is demonstrated by a number of quotes I have include in Attachment E.

V. WDFW LETTER COMMENTS

64. I have reviewed the portion of the letter pertaining to the impacts of vessel wakes.

65. The Washington Department of Fish and Wildlife (WDFW) has improperly concluded there would be impacts to unarmored shorelines and vegetated habitats in the lower 33 miles of the river. I believe this is based on the error that is woven through the DEIS due to the misunderstanding of results of Pearson et al. (2008). As I have previously testified, the lower 33-mile portion of the river is so wide that vessel wakes have very little energy when they interact with the shoreline. Therefore, the highest quality wetland and vegetated habitats in the entire vessel transit area are subject to little or no impact from vessel wakes due to the distance of the channel from the habitat and decay of the energy of the vessel wakes prior to reaching the shore.

66. The WDFW comment about more focus on shellfish, crustaceans, and other invertebrates in the estuary and marine portions of the study area appears to be partially based on concern about adverse impact of vessel wakes on habitat stability. As

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stated throughout my testimony, this is the portion of the river that is the least likely to be affect by vessel wakes rather than most likely

67. The WDFW correctly clarifies that wake stranding is more likely in areas of armored shorelines rather than just low gradient slopes. This observation is consistent with the emphasis I have placed on fine-scale morphological features and the conclusions of Coast and Harbor (2016) relative to stranding in my testimony. Sites like Barlow Point have armored shorelines in conjunction with beach morphology that does yield stranding. Coast and Harbor (2016) found that beaches with a wide upper beach and a small and/or steeply sloped lower beach had a low potential for fish stranding due to the dissipation of wake energy. Shorelines with a wide and flat lower beach with no or very small upper beach and typically with an armored backshore, do not have a mechanism for dissipating wake energy. It is the co-occurrence of several of these morphological conditions that yields a stranding beach. It is because many morphological conditions are necessary to yield standing that stranding sites are relatively rare in the Columbia River.

VI. ATTACHMENTS

68. I have attached the following Attachments to my testimony:

Attachment A:	Glenn Grette Resume
Attachment B:	Reference List for Testimony
Attachment C:	Grette Associates, Wake Stranding in the Lower Columbia River (2016)
Attachment D:	Potential Wake Stranding Locations in the Lower Columbia River as Predicted by Pearson et al. (2008)
Attachment E:	Impact Sections from the DEIS Affected by Erroneous Conclusions about Where Vessel Wake Stranding Occurs

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DATED this 13th day of May, 2016.

Glenn Grette

Glenn Grette, Declarant

STATE OF WA)
)
COUNTY OF CHELAN)

Glenn Grette, being duly sworn upon oath, deposes and says: The foregoing testimony is true, correct and complete to the best of my knowledge, information and belief and is given subject to the laws of perjury in the State of Washington.

GIVEN under my hand and official seal this 12TH day of MAY, 2016.

COLLEEN M. KIMBLE
Commission Expires
NOTARY PUBLIC
07-03-2018
STATE OF WASHINGTON

NOTARY PUBLIC in and for the State of:
WASHINGTON

Residing at: DOUGLAS COUNTY

My Commission Expires: 7-3-18

Printed Name of Notary:
COLLEEN M. KIMBLE

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