Comment on Coal Losses During the Ship-Loading Process

By Michael Riordan, Ph.D., 106 Hilltop Lane, Eastsound, WA, 98245

I am a physicist and writer living on Orcas Island, having moved here with my family in the summer of 2010 after owning a vacation home on the island since 2002. One of the primary reasons for this move was because I am an avid kayaker, and the San Juan Islands is one of this sport's premier destinations. What makes it so popular is the combination of abundant wildlife in, on and around its waters — including eagles, salmon, harbor seals, and orcas — together with its challenging tidal currents and magnificent shorelines. Most kayakers in the islands relate closely to this marine community and care deeply that it continues to thrive. This has been the case for me, too, ever since I first launched a kayak on Orcas over a decade ago.

I often kayak around the Outer Islands north of Orcas Island — Sucia, Matia and Patos — which are directly opposite Cherry Point across Georgia Strait, 7–8 miles away. The wildlife community around these uninhabited islands seems to be doing fairly well, especially the harbor seals that I often see breeding on their north shores. But long-time Orcas residents tell me that it has declined in recent decades, particularly the annual salmon runs that once drew sport fishermen from far away. Thus I am deeply concerned that activities at, or related to, the proposed Gateway Pacific Terminal at Cherry Point could have significant negative impacts upon the fragile marine community in the San Juan Islands.

Principal among these concerns is the possibility that coal (with its toxins) could escape from the terminal and find its way into Georgia Strait waters. From there it could then make its way physically or biologically to the San Juan Islands — drifting here via the strong currents and winds that characterize the area, or by uptake into the marine food chain, beginning with the Cherry Point herring that spawn in the waters off the coast of Whatcom County. Coal contains significant amounts of arsenic, cadmium, lead, mercury and polycyclic aromatic hydrocarbons, which are known carcinogens and/or neurotoxins. If ingested by the herring and other marine organisms low in the food chain, they would become concentrated in tissues of the salmon, harbor seals, seabirds and other wildlife that feed upon them.

As a Ph.D. physicist from MIT, I don't know much biology, but I do recognize how fine particles of coal dust can easily be wafted by winds far away from intended destinations in storage piles and ships. I have taught physics courses at Stanford and the University of California, and edited and published a book about wind power. I have also been involved in three large physics projects — two almost as big as the Gateway project and one much bigger. I have studied these large projects and their management, funded by the National Science Foundation and U.S. Department of Energy. So I know what can go seriously awry in such projects, despite the best-laid plans of dedicated engineers and scientists.

The plans for this coal terminal should therefore be scrutinized closely by regulators and compared with what has happened *in actual practice* at other bulk shipping terminals employing similar technologies — under similar weather and marine conditions. Abstract paper designs, engineering calculations, and computer simulations are not by themselves sufficient. Unanticipated events occur that can lead to the release of large amounts of coal dust. The best way to avoid them is to learn from real-world experiences and take measures to prevent their occurrence.

Coal Losses During Ship Loading

The process of loading 48 million tons of coal onto nearly 500 bulk carriers per year is fraught with potential dangers to the Cherry Point Aquatic Reserve. Primary among them is the escape of coal into these waters. Even if this loading process is 99.99 percent efficient, close to 5,000 tons of coal would be deposited there annually. It's inescapable, just simple arithmetic. If 99.999 percent efficiency could somehow be achieved — despite the inevitable operator errors, equipment malfunctions, and the strong winds characteristic of Cherry Point — almost 500 tons of coal per year will still find their way into local waters. That corresponds to the loss of just one ton per ship loaded, but over the lifetime of the terminal it would amount to many thousands of tons of coal accumulating on the sea floor near Cherry Point. Given its toxic elements, that great an accumulation of coal would probably cause irreparable harm to these waters and to the marine life dependent on them. Therefore coal losses in loading must be kept below a part per million, which is only about one gram or less than a teaspoonful per ton.

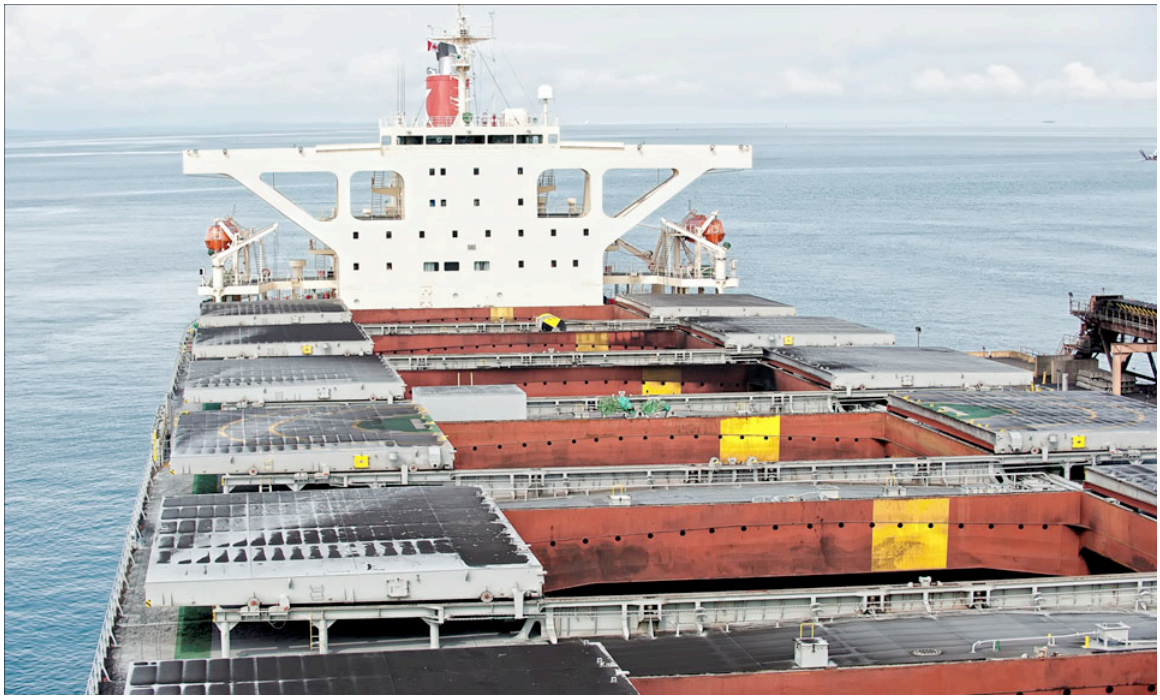

Figure 1. Coal dust on the deck of a bulk carrier during loading at Westshore Terminals. (Paul K. Anderson photo)

From actual, real-world experience at the nearby Westshore Terminals in Delta, BC, this exacting performance level in loading coal appears difficult, if not impossible, to achieve. The coal dust observed on the deck of the carrier in Fig. 1 is only a (most likely small) fraction of the losses that have occurred this early in the loading process, with the remainder entering the waters of Georgia Strait near the terminal. The dust pattern on the deck and hatch covers indicates that winds lofted this dust out of the holds during the loading process. This occurs naturally due to what physicists call the Bernoulli effect: winds blowing over an opening like this will generate an upward force — or negative pressure — that pulls fine particles up and out. If the ship-loading mechanism is not completely shut down while being moved from one hatch to the next, additional losses will occur. The fact that all the hatches must remain open for many hours during the loading process, to allow the operator to distribute the load evenly, leaves them exposed to any strong winds that arise during this period; the upward force will increase as the *square* of the wind speed at a given time. If the speed doubles, that is, the coal lost quadruples. And these losses worsen the nearer the hold comes to being filled; the dust then swirls up closer to deck level and is easier to blow out.

An aerial photo of the Westshore Terminals that is accessible via Google Maps at the address "Deltaport, Tsawassen, BC, Canada" (or through the web site *http://www.sourcewatch.org/index.php/Westshore_Terminals)* reveals another bulk carrier during the loading process. Coal can clearly be seen on the deck; its pattern suggests that it was dropped there by operator error during the loading process, while moving the ship loader from one hatch to the next. Also visible in the photograph is an accumulation of black material on the adjacent shoreline, almost certainly coal dust lost during loading operations.

A 2006 publication in the *International Journal of Coal Geology*, which examined coal accumulations on the sea floor around the Westshore Terminals showed that extensive deposits had accumulated during a 22-year period.[1] Coal concentrations of over 10 percent were observed at 350 meters from the terminal; 2 percent concentrations occurred as far as 1,750 meters away. Some of this may be due to fugitive coal dust from the storage piles and other operations at the terminal, which loses an average 715 tons of coal per year via this process.[2] But according to the 2006 article, the dominant fraction is due to losses during ship loading. Fig. 2, copied from the article, reveals the obvious high concentrations measured near Pod #1 and Pod #2, where coal loading occurs. Bigger, heavier particles sink rapidly to the sea floor near the terminal, the authors note, while smaller ones can float and drift for miles before sinking or washing up on shore.

Similar losses into the adjacent waters can be observed in aerial photos of other coal terminals, for example the International Marine Terminal operated by Kinder Morgan near Port Sulphur, LA.[3] In a Google Maps photo published in *Sightline Daily*, dark streaks in the water can be clearly seen streaming from its Mississippi River docks that are obviously due to coal losses during loading. Similar ship-loading losses are commonplace at coal terminals worldwide; they are endemic to the coal-transport industry.

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[1] Ryan Johnson and R. M. Bustin, "Coal Dust Dispersal Around a Marine Coal Terminal (1977–1999), British Columbia: The Fate of Coal Dust in the Marine Environment," *International Journal of Coal Geology,* Vol. 68, No. 1–2 (August 2006), pp. 57–69; see especially Figs. 2 and 8.

[2] Eric de Place, "Are Coal Export Terminals Good Neighbors?" *Sightline Daily*, 15 March 2011; in his article, de Place quotes this figure from Douglas L. Cope and Kamal K. Bhattacharya, "Coal Terminals: Fugitive Dust Emissions and Control," report to the Canadian Council of Ministers of the Environment, November 2001.

[3] Eric de Place, "Kinder Morgan's Coal Pollution on the Mississippi," *Sightline Daily*, 30 October 2012.

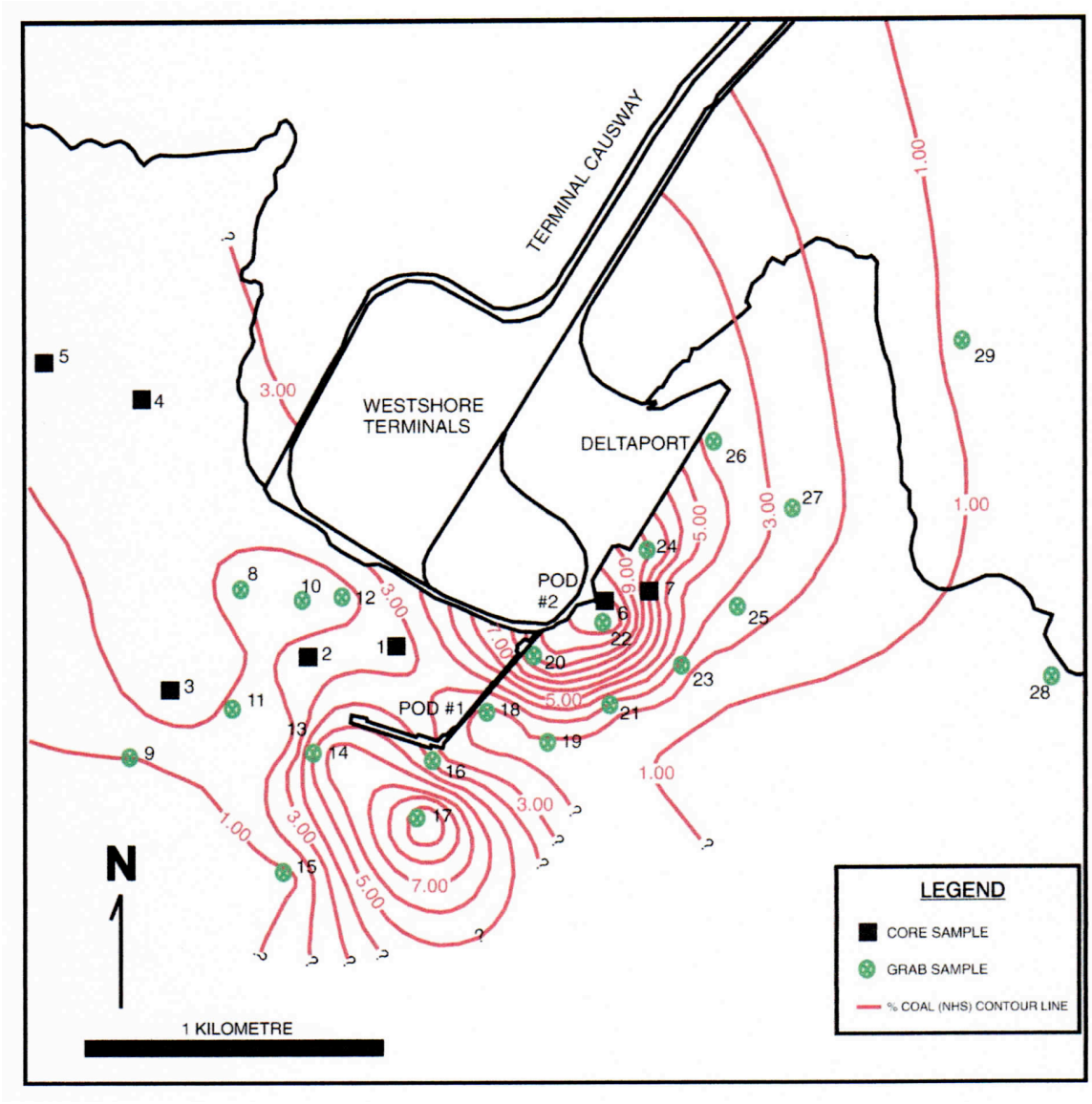

Figure 2. Coal concentrations in surface sediments near Westshore Terminals, Delta, BC. (Source: Johnson and Bustin, "Coal Dust Dispersal Around a Marine Coal Terminal.")

Based on the evidence presented here, losses of coal into the waters of the Cherry Point Aquatic Reserve would inevitably occur during the normal loading process at the proposed Gateway Pacific Terminal. The only questions remaining are how large these losses might be, given the gale-force winds often experienced at Cherry Point, and how significant the adverse impacts could be upon the local marine environment. Most of the fugitive coal would likely fall directly to the sea floor in the Reserve itself or wash up on adjacent shores and tidelands. Coal dust particles would infiltrate eelgrass beds where Cherry Point herring spawn and

probably reach nearby regions on the sea floor where Dungeness crab, shellfish and other bottom-feeders live, affecting local fisheries. Lighter coal dust particles would stay in the water for hours or days — drifting northwest, southeast and west with prevailing currents and winds. A small fraction of this suspended coal dust would likely reach Lummi Island and Orcas Island 7–10 miles away.

Studies and Actions Requested

I therefore respectfully request that the following questions be addressed in the Environmental Impact Statement for the Gateway Pacific Terminal:

1. Based on real experience at other coal terminals using similar equipment in similar conditions — for example, the Westshore Terminals in Delta, BC — what coal-loading efficiencies could be achieved *in actual practice* under normal operating conditions? What quantity of coal would consequently escape into the waters of the Cherry Point Aquatic Reserve per year? How much of the coal lost would fall directly to the sea floor, and how much of it would drift away to other regions, near and far, of Georgia Strait?
2. What measures could be taken by terminal managers to reduce coal lost during the ship-loading process — for example, by mandating stricter operating procedures, regular equipment inspections and servicing, and halting the coal loading in high-wind conditions? At what wind speeds should loading be halted and the ship hatches closed to prevent losses?
3. What are the likely impacts upon Cherry Point marine life — principally the Cherry Point herring that spawn there every spring and Dungeness crab that feed on the sea floor — of the coal that would accumulate in the Reserve during the many years the terminal would operate, despite these measures? What are the likely impacts on the eelgrass beds, which help filter carbon dioxide out of the seawater, reduce its acidity, and store the carbon? What about the impacts further distant from Cherry Point — for example at Lummi Island, Orcas Island and the Outer Islands north of it?

Thank you for your serious consideration of these questions and impacts, which I — and many others — consider very significant. Without satisfactory resolutions of these crucial questions, the proposed Gateway Pacific Terminal project should not be permitted to proceed.