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November 18, 2013

Millennium Bulk Terminals-Longview EIS
c/o ICF International
710 Second Avenue, Suite 550
Seattle, WA 98104

Dear Co-Lead Agencies' Representatives for Cowlitz County, WA State Department of Ecology, and U.S. Army Corps of Engineers:

As a resident of Washington state, and more specifically the San Juan Islands, please accept the attached Environmental Impact Statement Scoping Comment on *The Risks Associated with Dust and Wind at the Proposed Site* relevant to the Millennium Bulk Terminals Longview (MBTL) permit application, developed in consultation with Al Gillespie.

Based on the findings of significant and unmitagatable adverse impacts, I ask that you deny the permit for the proposed Millenium Bulk Terminals Longview (MBTL).

Sincerely,

Ms. Sophia M. Shoen

Environmental Impact Statement Scoping Comments for the proposed Millennium Bulk Terminals Longview:

The Risks Associated with Dust and Wind at the Proposed Site

Sophia Shoen/Alexander Gillespie

November 5, 2013

1. The base problem

According to the proposal by Millennium Bulk Terminals (MBT) Longview, when the facility is at capacity and shipping a 'nominal' 44 million metric tons of coal per year, it will be a 24 hour operation, running seven days per week. This site itself will cover approximately 100 acres of the 416 acre property and would consist of rail unloading, storage, reclaiming and loading ships with coal via two docks, two ship-loaders, four stockpile pads, 8 rail lines and associated facilities, conveyors and equipment. Coal would be 'discharged' at the sites, stacked into different stockpiles and then conveyed onto a ship (with an approximate time to load and dispatch a ship being 24 hours).[1]

In order to achieve these goals, there will be a considerable disturbance to this area to facilitate the requested additions to the MBT Longview site. While many parts of the site will be improved from their current conditions (especially in terms of the clean-up from previous operations) and redeveloped, and this is to be welcomed, considerable new impacts need to be critically examined. Within this mix, the loss of approximately 24 to 30 acres of wetlands is an overt concern, as will be the ongoing dredging that will be required to keep the waters at a suitable depth. In both instances, it can be expected that the Environmental Impact Statement (EIS) will ensure that the proposal is in full compliance with the rules on biological offsetting for the wetlands (and will show how the offsetting can be achieved and to what standards, depending on what is being lost)[2] as well as the rules on dredging (and, in particular, on the disposal of toxic dredging) that cannot be placed back into the river. However, despite the merit of these two aspects of the EIS, the foremost concern is that the most significant risk associated with this operation, which is currently being overlooked, is the escape of coal dust. This dust will come from the stockpiled coal itself, as well as dust that escapes when coal is being unloaded from the train and moved onto ships.

Coal dust is an odorless, fine powdered form of dark brown to black dust created by the crushing, grinding, or pulverizing coal.[3] Its most explosive risk is in combustion and flammability. Coal dust also possesses the ability to cause longer term, detrimental impacts upon both humans and animals. These impacts may appear wherever coal is obtained, stockpiled and, particularly, when it is transported, dumped or otherwise handled (e.g. loading, unloading). At all of these stages there is the likelihood for the release of small particulate matter (i.e., dust) in significant quantities. Particulate matter, also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as

[1] 2010 Washington State, Joint Aquatic Resources Permit Application: Millennium Bulk Terminals Longview. 2012, February 2nd. Available < http://www.ecy.wa.gov/geographic/millennium/20120222_JARPAapplication.pdf> Section 6a and 6d.

[2] Gillespie, A. (2012). *A Missing Piece of the Conservation Puzzle: Biodiversity Offsets*.(Department of Conservation, Wellington, NZ). UNDP (2011). *State of Biodiversity Markets: Offset and Compensation Programmes Worldwide, the 2011 Update*. (UNDP, NYC). V,.

[3] Commonly, it is identified by its content of silicon dioxide which is most commonly found in nature in sand or quartz, with it containing less than 5% of free silica.

nitrates and sulfates), organic chemicals, metals, and soil or dust (including coal dust) particles. Particle size is directly linked to their potential for causing health problems in humans. Similarly, the deposition of coal dust can also cause significant impacts upon local ecological systems.

Specifically, strong evidence already exists that industrial ports are often primary sources of pollution. This problem is often exacerbated when the ports are involved in the shipment of coal, and significant concentration of fugitive coal particles escape from point sources (e.g., industrial loading and storage facilities) via both normal operations and natural assistance (such as wind drift).[4] These emissions have been linked to impacts upon both local human communities, as well as the local ecology. These concerns have led to legal challenges at coal ports in, *inter alia*, Australasia, Africa and India.[5] In terms of environmental damage, the problem may build up over a prolonged period of time, resulting in a detrimental impact to the local terrestrial[6] and aquatic environment (depending on the qualities and quantities of the coal dust, and exactly how susceptible the local ecology is to be the pollutant).[7]

As it stands, the current proposal from MBT Longview explains:

> Dust suppression systems and use of enclosed conveyors and transfer points would minimize potential for fugitive dust to reach surface water. MBTL would be responsible for creating and following an operational Spill Prevention, Control and Countermeasures Plan…. Impacts to surface water from dust and coal spills in overwater areas would be controlled through the adherence to the applicable regulations for the reduction or control of dust emissions. The trestle conveyor is anticipated to be fully enclosed which would minimise the impact from coal spills, dust and untreated stormwater runoff from the docks. The dock and trestle coal handling infrastructure design are also anticipated to include methods to collect and treat spills that occur within the enclosure…. [to] … further avoid or minimise the adverse impacts due to coal spills or untreated stormwater runoff to the surface water.

It then adds:

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[4] Moreno, N. (2007). 'Characterisation of Dust Material Emitted During Harbour Operations'. *Atmospheric Environment.* 41(30): 6331-6343. Bailey, D. (2004). 'Pollution Prevention at Ports: Clearing the Air'. *Environmental Impact Assessment Review*. 24(7): 749-774.

[5] Banks, K. (2013). 'Coal Dust Inquiry Begins'. *The Queensland Times*. June 11. 2. Thompson, T. (2012). 'State Puts Coal Dust Polluters on Notice'. *The Courier Mail.* Dec 20.5. Higginbotham, N. (2010). 'Environmental Injustice and Air Pollution in Coal Affected Communities'. *Health and Place.* 16(2): 259-266. Anon (2009). 'Village Sick of Coal Dust Ordeal'. *The Bangkok Post.* May 16. 2. Haj, R. (2008). 'Residents Up in Arms Against Coal Dust Pollution'. *The Times of India.* March 11. 3. Anon (2002). 'Coal Dust Problems: Court Issues Injunction'. *Platts International Coal Report.* Oct 22.

[6] Bounds, W. (2007). 'Arsenic Addition to Soils from Airborne Coal Dust Originating at a Major Coal Shipping Terminal'. *Water Air Soil Pollution* 185:195–207. Spencer, S. (2001). 'Effects of Coal Dust on Species Composition of Mosses and Lichens in an Arid Environment'. *Journal of Arid Environments* 49: 843-853. Spencer, S. (1997). 'Effects of Coal Dust on Plant Growth and Species Composition in an Arid Environment'. *Journal of Arid Environments* 37: 475–485.

[7] Bounds, W. (2007). 'Arsenic Addition to Soils from Airborne Coal Dust Originating at a Major Coal Shipping Terminal'. *Water, Air and Soil Pollution*. 185(1): 195-207. Johnson, R. (2006). '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* 68: 57–69. Naidoo, G. (2004). 'The Effects of Coal Dust on Photosynthetic Performance of the Mangrove'. *Environmental Pollution*. 127(3): 359-366. French, P. (1998). 'The Impact of Coal Production on the Sediment Record of the Severn Estuary'. *Environmental Pollution*. 103(1): 37-43. Allen, J. (1987). 'Coal Dust in the Severn Estuary, Southwestern UK'. *Marine Pollution Bulletin.* 18(4): 169-174.

> MBTL anticipates obtaining a new permit to allow discharge via an existing outfall that discharges into to the river. Stormwater design includes a system to harvest and re-use stormwater on site for dust control. Stormwater from the trestle, dock, and access approach would be collected and treated for water quality with media filter systems then discharged directly into the Columbia River or pumped from the dock to the upland stormwater treatment facilities. … Site stormwater would be managed according to Cowlitz County requirements.[8]

While some of these broad objectives are commendable (such as having a fully enclosed trestle conveyor system, the use of stormwater for dust control and the need for the discharged stormwater to comply with both local and federal standards), the proposal omits to examine a number of other critical features. The most notable of these is the actual stockpiles of coal and how well these are kept from impacting upon the local ecology. The primary driving force for the creation of coal dust at this location will be wind as stockpiled coal provides an erodible surface for the wind generation of particulate matter emissions. Such dispersals of dust from coal piles are primarily governed by conditions with fluctuating wind rather than wind with constant flow rate. The characteristics of fluctuating wind depend on the weather (e.g., wind speed, wind direction, stability), terrain roughness and particle size with smaller sized particles being much more likely to become airborne than heavier ones.[9]

2. Indicators of significant risk

In order to be approved, the MBT Longview development must reconcile a large number of relevant regulatory and legislative standards, as well as standards from other legal and policy instruments at the regional, state, and federal levels, all of which address issues of potential significant risk. A summary of some of the more relevant standards are provided below:

- The Endangered Species Act
- The Coastal Zone Management Act
- The Fish And Wildlife Coordination Act
- The Magnus-Stevens Fishery Conservation and Management Act-Essential Fish Habitat
- The Pacific Salmon Treaty
- The Oregon Fish and Wildlife Habitat Mitigation Policy
- The Clean Water Act
- The Columbia Gorge National Scenic Area Act

[8] 2010 Washington State, Joint Aquatic Resources Permit Application: Millennium Bulk Terminals Longview. 2012, February 2nd. Available from, < http://www.ecy.wa.gov/geographic/millennium/20120222_JARPAapplication.pdf> Section 8a.

[9] US Environmental Protection Agency (2006). AP 42, 5th ed.,, Volume I, Chapter 13: Miscellaneous Sources, 13.2.5 Industrial Wind Erosion, Technology Transfer Network, Clearinghouse for Inventories & Emission Factors. http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0205.pdf. Also, Vrins, E. et al. (1998). 'Monitoring and Control of Fugitive Coarse Dust Sources'. *Journal of Aerosol Science*. 29: 709-740. Vrins, E. (1996). 'Sampling Requirements for Estimating Fugitive Dust Emissions'. *Journal of Aerosol Science*. 27(l.): 571-572. Visser, G. (1992). 'A Wind Tunnel Study of Dust Emissions'. *Atmospheric Environment* 26: 1453-1460.

- The State Water Pollution Control Act
- The Clean Air Act and associated National Ambient and State Air Quality Standards.

3. The significant risks of coal dust associated with the stockpile

In addition to posing a risk to associated human communities, coal dust from the proposed MBT Longview site also represents a significant risk to the local ecology. The proponents of this project recognize that a number of threatened or endangered species, which have critical habitat already designated, are in the vicinity of the actual proposed site at Longview. The ones they identify as endangered, with critical habitat designated, and in the vicinity are Chinook salmon (of the Upper Columbia River, spring run) and Sockeye salmon (of Snake River). Those with a threatened status, with critical habitat designated and in the vicinity, include Chinook salmon (Snake River, fall run and the Snake River spring/summer runs), Chum salmon (Columbia River), Steelhead trout (Snake River, Upper, Middle and Lower Columbia, and Upper Willamette Rivers), as well as Bull Trout (Columbia River) and Eulachon smelt (Columbia River). [10]

Although the proponents of this project have recognized this situation as a concern, the extent of this concern is underestimated. Chinook and Steelhead salmon of the Columbia River are explicitly recognized as endangered and threatened with extinction under the Endangered Species Act.[11] The salmon in this river (and its wider basin) once ran at between 10 to 16 million returning to the basin per year. Currently, less than 1 million adult salmon pass the Bonneville Dam each year. [12] Cumulative impacts over a sustained period of time involving the destruction of their habitat by damming, over-harvesting, persistent pollutants and even disturbance from deep draught vessels.[13] These species, which are also a critical part of the diet of the equally endangered Southern Resident Killer Whales (SRKW),[14] are also subject to further conservation considerations under the Fish and Wildlife Coordination Act, the Magnus-Stevens Fishery Conservation and Management Act-Essential Fish Habitat,[15] and international conservation efforts under the 1985 Pacific Salmon Treaty[16] (and its 2008 revision).[17] As species listed under the Endangered Species Act, they also have defined

[10] 2010 Washington State, Joint Aquatic Resources Permit Application: Millennium Bulk Terminals Longview. 2012, February 2nd. Available from, < http://www.ecy.wa.gov/geographic/millennium/20120222_JARPAapplication.pdf> Section 9k

[11] See NOAA, *Endangered and Threatened Species; 5-Year Reviews for 17 Evolutionarily Significant Units and Distinct Population Segments of Pacific Salmon and Steelhead*. 50448 Federal Register / Vol. 76, No. 157 / Monday, August 15, 2011 / Proposed Rules.

[12] EPA (2009). *Columbia River Basin: State of the River Report for Toxics*. (EPA, Washington). 3.

[13] Pearson, W. (2011). 'Factors Affecting Stranding of Juvenile Salmonids By Wakes from Ship Passage in the Lower Columbia River'. *River Research and Application*. 27(7): 926-936. EPA (2009). *Columbia River Basin: State of the River Report for Toxics*. (EPA, Washington). 4.

[14] National Marine Fisheries Services (2012). *The Effects of Salmon Fisheries on Southern Resident Killer Whales: Final Report of the Independent Science Panel.* (NOAA, Seattle). 3-4. National Marine Fisheries Service (2011). *Southern Resident Killer Whales: Five Year Review* (NMFS, Seattle). 6.

[15] Public Law 94-265.

[16] *The Treaty Between the Government of Canada and the Government of the United States of America Concerning Pacific Salmon*. See in particular, article 3.

[17] See Chapter 3 of Annex IV of the Treaty.

critical habitat that must be protected.[18] These Federal obligations to protect the critical habitat of the endangered and threatened Salmon and Steelhead in the Lower Columbia River have been reiterated by the authorities in both Oregon[19] and Washington,[20] as well as by national organizations such as the National Oceanic and Atmospheric Administration (NOAA) with their most recent 2013 Lower Columbia River Recovery Plan for Salmon & Steelhead.[21]

4. Alternatives

The best case alternative involves the creation of infrastructure whereby the deposited, held, and then transferred coal is not placed in situations whereby its dust can cause difficulties to local human communities and/or the local ecology. The largest industrial structures have a useable floor area of between 2 and 4+ million square feet (i.e., 98 acres) with useable volumes of 250-470+ million cubic feet.[22] While the cost of building such a facility would be considerable, there are equivalent precedents with the storage of other bulk items such as grain that must be kept under cover, generally in silos or bins, to keep it dry. Such an alternative should at least be considered as should the covering of coal wagons during transport. Together, these options would reduce coal dust emissions for transport and storage to nearly zero. The best examples of this type of approach are found both internationally and locally. Good international examples of best practice in this area can be found New Zealand, where fully-enclosed coal storage operations are required in a number of industrial ports.[23] Equally impressive examples of good practice in this area can be found the proposed Morrow Pacific Project. The base site for this facility, that will eventually export 8 million metric tons of coal annually, will have a storage area which is not just covered but, rather, is fully enclosed.[24]

5. Mitigation

If the best case alternative of having sites partially or fully enclosed cannot be achieved, then the problem can only be mitigated. In this area, the most fundamental concern is that stockpiles should not be placed in areas of high wind. Alternative, more settled, locations should always be sourced as the overt primary threat in all locations of stored coal is wind

[18] *See http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/chinooksalmon.pdf*
[19] Oregon Department of Fish and Wildlife (2010). *Lower Columbia River Conservation & Recovery Plan for Oregon Populations of Salmon & Steelhead.* (ODFW, Eugene).
[20] Puget Sound Partnership (2012). *The 2012 State of the Sound: A Biennial Report on the Recovery of Puget Sound.* (PSP, Seattle). 22, 24. National Marine Fisheries Service (2007). *Puget Sound Salmon Recovery Plan* (NOAA, Washington).
[21] NOAA (2013). NOAA (2013). *Lower Columbia River Recovery Plan for Salmon & Steelhead.* (NOAA, Washington).
[22] *Boeing Everett Tour Fact Sheet*. Available at http://www.boeing.com/commercial/tours/background.html. Downloaded on 2nd January 2013.
[23] See Port of Tauranga (2012). *Port for the Future*. (Tauranga). 5-8.
[24] The Morrow figures are from AmbreEnergy (2013). *The Morrow Pacific Project: Powering America and the World.* (AmbreEnergy). 7.

strength and its persistence. That is, if coal stockpiles are in the wrong location, no amount of mitigation will stop the release of coal dust. As such, the first alternative must always be that, where possible, the site should not be placed in a location with excessive amounts of wind.[25]

Once an area with the lowest possible amount of wind has been secured, then additional methods of control can be utilized. This is not a new problem. Since 1941, scientists have expended a great amount of effort in trying to understand and control the impact of wind upon particulate matter, which can become airborne.[26] Many examples can be cited including the prevention of desert expansion and farmland erosion but of most relevance to this assessment is the examination of airborne coal dust emissions. The main focus of these investigations has been upon efforts to keep wind off the material which is volatile to being made airborne. Various mitigation options are available in this area (e.g., moisture, wind-breaks, pile geometry and management of the pile) that can, when combined, provide limited protection for a period of time. That period of time is always dependent on the elements that the stockpile is exposed to. Each of these mitigation measures should be critically examined.[27]

Surfactants and wetting

One method that is being used more and more to reduce dust emissions is to ensure that the coal is to add surfactants to it. Surfactants are compounds that lower the surface tension (or interfacial tension) between two liquids or between a liquid and a solid. In the case of coal, surfactants are used as wetting agents, whereby making particles wet, they affix to the bulk material. In practice, each type of coal exhibits a critical moisture content around which no emissions occur. The problem, is that not all coal is the same, and different types of surfactants achieve different results. The finer the coal particle sizes, the more complex the coal particle micro structures, and the greater degree of sulphur can all influence the effectiveness of the surfactant in keeping the coal wet and the dust on the bulk material. In general, wetting performance is poor for the coal with higher volatile content due to the easier release of volatile matter and the easier formation of gas film around the particle. However, wetting can be improved if different types, or mixes, of surfactants are applied. In this regard, the differences between ionised and deionised water can be great, along with the addition of other chemicals, such as sodium dodecyl sulphate. A similar alternative is to spray the coal with a surfactant or protective layer, such as polyoxyethylene and polyglycerol-based nonionic surfactants. This is achieved through using a water additive that forms a skin over the coal, thereby keeping the dust in. In such instances, the most effective surfactants increased the ability to suppress overall coal dust levels by up to 100% when compared with plain water.[28]

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[25] Cowherd, C. (1981). 'Control of Windblown Dust from Storage Piles'. *Environment International.* 6: 3

[26] Bagnold, R. (1941). *The Physics of Blown Sand and Desert Dunes*. (Methuen, London).

[27] Smandych, R. (1998). 'Dust Control for Material Handling Operations: A Systematic Approach'. *American Industrial Hygiene Association Journal*. 59(2): 139-146.

[28] Baiquan, L. (2013). 'Surface Physical Properties and Its Effects on the Wetting Behaviour of Respirable Coal Mine Dust'. *Powder Technology*. 233: 137-145. Ding, C. (2011). 'Experimental Research on Optimization and Coal Dust Suppression'. *Procedia Engineering*. 26: 1314-1321. Keystone Environmental (2011). *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Office

However, both water and protective layers can be negated by opposing forces of wind and excessive moisture (i.e., rain). If these forces are superior to the bonding agents, the fugitive dust will continue to escape, typically, downwind. While this approach of surfactants is used on loaded coal wagons, surfactants other than standard water are not generally used on coal stockpiles but this issue should be examined, if applicable to the management of coal dust at the site.

This is also essential as scientific evidence is emerging that in some instances, certain surfactants may be leading to conservation concern. The difficulty is that this concern is not always direct, and may take the former of indirect impacts that may build up within species and/or ecosystems over a prolonged period of time. Accordingly, in accordance with best national and international practice in this area, it would be prudent to undertake studies, on a precautionary basis,[29] to see the size of the potential emissions of surfactants used to suppress coal dust at the port, to examine the different conditions that loss may occur, and if the proposed surfactants have the potential to bioaccumulate, magnify and detrimentally impact upon the surrounding environment and, in particular, species and areas of particular conservation concern.[30]

Wind barriers

The second mitigation option is the utilization of barriers, such as fencing, shelter-belts or windbreaks to prevent the potentially volatile material from becoming airborne. Evidence already suggests that if wind barriers are made of appropriate material, are set at appropriate heights and depths (more than one layer) and configurations (e.g., rectangles, octagons, open boxes, etc.) they can be effective in controlling the spread of dust with success rates (in ideal conditions) of up to 85%.[31] However, in order to achieve such high levels of mitigation,

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of Environment and Heritage, KE1006953, NSW). Marsalek, R. (2008). 'The Influence of Surfactants on the Zeta Potential of Coals'. *Energy Sources*. 31(1): 66-75. Tien, J. (1997). 'Respirable Coal Dust Control Using Surfactants'. *Applied Occupational and Environmental Hygiene.* 12(12): 957-963. Kim J. (1994). 'The Effect of Added Base on Coal Wetting Ability of Non-ionic Surfactant Solutions Used for Dust Control'. *Mining Engineer,* 154: 151-155. Smitham, J. (1991). 'Physico-Chemical Principles Controlling the Emission of Dust from Coal Stockpiles'. *Powder Technology*. 64(3): 259-270.

[29] Warshaw, J. (2012). 'The Trend Towards Implementing the Precautionary Principle in US Regulation'. *Dose-Response*. 10(3): 384-13. Gillespie, A. (2011). 'Precautionary New Zealand'. *New Zealand Universities Law Review*. 24(3): 364. Hansen, S. (2011). 'Chemical Regulation and Precaution'. *Environmental Science and Policy*. 10(5): 395-404. Gouin, T. (2010). 'The Precautionary Principle and Environmental Persistence'. *Environmental Science and Policy.* 13(3): 175-184. Jostmann, T. (2007). 'The Precautionary Principle for Toxic Chemicals'. *Human and Experimental Toxicology.* 26(11): 847-849. Gillespie, A. (2007). 'The Precautionary Principle in the Twenty-first Century'. *The International Journal of Marine ad Coastal Law.* 22(1): 61. Lokke, S. (2006). 'The Precautionary Principle and Chemicals Regulation: Past Achievements and Future Possibilities'. *Environmental Science and Pollution Research Institute.* 13(5): 342-349.

[30] Capaldo, G. (2012). ' Endocrine-Disrupting Effects of Nonyphenol in the Newt, Tritus Carnifex'. *Comparative Biochemistry and Physiology.* 155(2) 352-358. Yan, W. (2012). 'Dust Suppression with Glycerin from Biodiesel Production'. *Journal of Environmental Protection*. 3(2): 218-224. Dixon, D. (2008). 'The Use of Oil Refinery Wastes as a Dust Suppression Surfactant'. *Environmental Engineering Science.* 25(8): 1189-1196.

[31] Cong, X. (2011). 'Impact of the Installation Scenario of Porous Fences on Wind-Blown Particle Emission in Open Coal Yards'. *Atmospheric Environment* 45 (2011) 5247-5253. Cheng, Y. (2010). 'An investigation into the Sheltering Performance of Porous Windbreaks under Various Wind Directions'. *Journal of Wind Engineering and Industrial Aerodynamics*. 98: 520–532. Park, C. (2003). 'Experimental Study on Surface Pressure and Flow Structure around a Triangular Prism Located Behind a Porous Fence'. *Journal of Wind Engineering and Industrial Aerodynamics* 91(1): 165–184. Lee, S. (2002). 'Wind Tunnel Observations about the Shelter Effect of Porous Fences'. *Atmospheric Environment* 36: 1453–1463. Park, C. (2002). Verification of the Shelter Effect of a Windbreak on Coal Piles in the POSCO Open Storage

barriers must be optimally designed for the local conditions and built and then maintained to a high standard.

Stockpile geometry

The third mitigation to be investigated is the geometry of the pile. The geometry of the stockpile - especially including the height, size, compaction and primary shape facing the dominant wind direction - can have a strong impact upon the amount of coal dust that is generated with differences ranging from between 13 and 60% reductions in emissions (in ideal situations) when the correct shape is utilized.[32] However, as identified previously, to achieve these levels of mitigation, stockpiles must be optimally designed for the local conditions and continuously maintained to a consistently high standard.

Minimizing disturbance

The fourth mitigation is to ensure that already settled piles are disturbed as little as possible, as, over time, the surface of an undisturbed stockpile will become depleted in erodible material and emissions of particulate matter will reduce. If stockpiles are frequently disturbed, fresh surface material will be exposed restoring the erosion potential and the problem will continue to repeat itself. With respect to the handling of coal from the trains to the stockpiles, or the port to the vessel, best practice measures to control emissions are the use of volumetric loading from an overhead silo or bin with a telescopic chute with the entire activity enclosed within a set space.

6. Recommended research programs

Based on the assessment of the various risks posed by coal dust from the proposed MBT and a consideration of potential alternatives and potential mitigation options that are contained in this report, four research studies are recommended to assist in developing an understanding and evaluation of the impacts of the MBT.

Yards at the Kwang-Yang Works'. *Atmospheric Environment* 36: 2171. Lee, S. (1999). Laboratory Measurements of Velocity and Turbulence Field Porous Fences. *Journal of Wind Engineering and Industrial Aerodynamics* 80: 311–329. Stunder, B. (1988). 'Windbreak Effectiveness for Storage Pile Fugitive Dust Control'. *Journal of the Air Pollution Control Association* 38: 135–143. Borges, A. (1988). Shelter Effects on a Row of Coal Piles to Prevent Wind Erosion'. *Journal of Wind Engineering and Industrial Aerodynamics* 29: 145–154. US Environmental Protection Agency (1986), *Field Evaluation of Windscreens as a Fugitive Dust Control Measure for Material Storage Piles,* Document EPA/600/S7-86/027. Billman, B. (1985). *Windbreak Effectiveness for Storage-Pile Fugitive Dust Control.* USEPA Report No. EPA/600/3 - 85/059.

[32] Cong, X. (2012). 'Effect of Aggregate Stockpile Configuration and Layout on Dust Emissions in an Open Yard'. *Applied Mathematical Modelling* 36: 5482–5491. Turpin, J. (2009). Numerical Modeling of Flow Structures over Various Flat-Topped Stockpiles Height: Implications on Dust Emissions'. *Atmospheric Environment* 43: 5579–5587. Torano, J. (2009). 'Dust Emission Calculations in Open Storage Piles Protected By Means of Barriers'. *Environmental Fluid Mechanics.* 9(5): 493-507. Torano, R. (2007). 'Influence of the pile shape on wind erosion CFD emission simulation'. *Applied Mathematical Modelling* 31: 2487–2502. Badr, T. (2007). 'Effect of Aggregate Storage Piles Configuration on Dust Emissions'. *Atmospheric Environment* 41 (2007) 360–368. Badr, T. (2005). 'Numerical Modelling of Flow Over Stockpiles: Implications on Dust Emissions'. *Atmospheric Environment* 39: 5576–5584. IEA Coal Research. (1994). *Control of Coal Dust in Transit and in Stockpiles.* (IEA, London).

(i). The first study that should be undertaken is of the utility of adopting best practice in this area, and either fully, or partially, enclosing the entire site to control the spread of coal dust.

(ii). The second study should focus upon the natural features that are likely to make the potential for impacts from the site either better or worse. At base, the wind speed and direction must be carefully mapped, along with other important weather related activities that may have influence (such as storms) and then juxtaposed against how the handling and storage of the coal will respond to these features. The responses that need to be examined are the geometry of the stockpile, how often the coal will be moved (including reshaping, compacting and maintenance by bulldozers) and the composition of the coal itself (e.g., the size distribution of the coal particles and the chemical composition).

(iii). The third study needs to be built upon the conclusions of the second study. That is, once a clear view of the likely levels of emissions from the stockpile and associated activities is clear, these emissions should be juxtaposed against the adequacy of the possible mitigations of surfactants and wetting, wind barriers and enclosure. The adequacy of these mitigations then needs to be measured against the potential impacts the coal dust may have on associated local communities and the local ecology. In particular, the potential impacts of coal dust from the port upon the marine environment.

(iv). The fourth study needs to examine the implications on the local freshwater ecosystems for mitigation techniques such as wetting and surfactants wherein which it will be necessary to study the impacts of the water required, in terms of quantity and quality and the indirect effects this may have on associated ecosystems and associated species (especially those of a conservation concern), and compliance with associated laws and regulations.