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The Right to Know, the Duty to Inquire the Obligation to Act

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Comments on the Deepening, Lengthening and widening of Berth 203 to 205, Pier 2, Container Terminal, and Port of Durban- Amended EIA report

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Introduction

The amended EIA fails to adequately assess the impacts of climate change and sea level rise. Of primary concern is the vulnerability of the port to sea level rise and storm surges. The amended EIA does not address concerns that as a result of the construction and opening up of the bay, the project will leave the port and sandbanks structurally more susceptible to damage from sea level rise and storm surges.

Further, the height of the freeboard is clearly insufficient and will allow flooding of the port under storm conditions. According to the author's calculations, an estimated 32.4cm separates the freeboard from the surface water. 32.4cm does not provide much room for errors in estimation, and we show here that the calculations are based on a misreading of the IPCC's 2013 report on the physical science. They rely on spurious assumptions, broad simplifications, and a general lack of understanding of the complex nature of climate change and sea level rise. A proper assessment must assume a rise in sea level of at least

2 meters and model tides, sediment transport and storm surge on that basis. We recommend that the amended EIA be rejected.

Sea Level Rise (SLR) Miscalculation

The amended EIA says that the IPCC's fifth assessment report, Climate Change 2013: The Physical Science Basis, "has been adopted as the primary reference for this report" [59]. On this basis, it makes the following statement:

> *The IPCC Climate Change 2013 predictions for Global Mean Sea Level Rise to the year 2100 ranges from 0.26m to 0.82m for the various Representative Concentration Pathways (RCP) scenarios. For RCP8.5, the worst-case scenario, a likely range of 0.45m to 0.82m is predicted by 2100. [53, 54]*

This is a misreading of the IPCC report. The range of projections for sea level rise by 2100 is 0.28m to 0.98m and for RCP8.5 it is 0.52m to 0.98m. This is the relevant passage from IPCC 2013:

> *Global mean sea level rise for 2081−2100 relative to 1986–2005 will likely be in the ranges of 0.26 to 0.55 m for RCP2.6, 0.32 to 0.63 m for RCP4.5, 0.33 to 0.63 m for RCP6.0, and 0.45 to 0.82 m for RCP8.5 (medium confidence). For RCP8.5, the rise by the year 2100 is 0.52 to 0.98 m, with a rate during 2081–2100 of 8 to16 mm yr–1 (medium confidence). [SPM-18]*

The amended EIA thus mistakes the mean sea level rise for 2081−2100 relative to 1986–2005 for the likely sea level rise by 2100 and is 16 centimeters short of the correct value for RCP8.5. All subsequent calculations, including the sensitivity analysis, of the implications for the port are thus also wrong.

IPCC Projections Underestimate SLR

The amended EIA misses this from the IPCC report:

> *Based on current understanding, only the collapse of marine-based sectors of the Antarctic ice sheet, if initiated, could cause global mean sea level to rise substantially above the likely range during the 21st century. However, there is*

medium confidence that this additional contribution would not exceed several tenths of a meter of sea level rise during the 21st century. [SPM-18]

The implication is that the upper limit is raised to something between 1.2m and 1.5m according to Anders Levermann, a lead author of the sea level chapter (RealClimate 2013). Obviously, the lower limits would rise by the same amount.

More troubling is research published by NASA in May this year that shows the collapse of the West Antarctic Ice Sheet has indeed been 'initiated' (Rignot & Mouginot 2014). This would over time cause sea levels to rise by roughly 5m (Mitrovica et al. 2009). Pennsylvania State University professor of geosciences Sridhar Anandakrishnan, who was not associated with the study, commented that because of this new finding, previous SLR projections underestimate the magnitude of the upcoming SLR and that "projections by the Intergovernmental Panel on Climate Change (IPCC) do not yet include Antarctic contributions to any great measure because the IPCC focuses on the public record and because some study results are only recently starting to come together about West Antarctica and this sector" (Showstack 2014).

The conservatism of the IPCC is well known and the IPCC projections are well behind expert opinion. SLR projections in the IPCC 2001 Third Assessment Report and the IPCC 2007 Fourth Assessment Report were biased low by roughly 60% (Rahmstorf et al. 2007, 2012, Rignot 2011, SkepticalScience 2012). Although the newest (2013) IPCC report's projections used in the amended EIA sought to correct some of the previous modeling errors, SLR experts clearly believe that the figures are still quite conservative (Horton et al. 2014). Commenting on a survey of leading climate scientists whose research focuses on sea level, Stefan Rahmstorf, of the Potsdam Institute for Climate Impact Research in Germany, says: "For the red scenario [RCP8.5], about half of the experts (51%) gave 1.5 meters or higher … a quarter (27%) … 2 meters or higher … for the increase from 2000 to 2100 (RealClimate 2013)." The majority of these internationally recognized SLR researchers agree that the IPCC projections underestimate future change.

We believe that these higher projections should be taken into account. Port Development should plan for a minimum of 2.0m in SLR by 2100. Williams (2013) advises governments to plan for a SLR of up to 2m by 2100. Mather et al. (2012), a source cited by the amended EIA, actually recommends for South African ports not only to be designed to last longer than 100 years (in contrast to the proposed 50 years) but also to plan for 2m in SLR (in contrast to the amended EIA's aforementioned erroneous .82m).

Contributions of More Frequent and Intense Cyclones to Storm Surge

Durban is certainly not immune to the impacts of cyclones. Indeed, the KwaZulu-Natal coastline was struck by the swells of two separate cyclones in 2007 alone and caused an estimated US$100 million in damage. These types of storms will continue and may become more frequent and intense (Mavume et al. 2009).

Globally, cyclones have become more intense, with stronger winds, rainfall, and surge levels, and as a result of the continual rise in sea-surface temperatures this trend will continue (Webster et al. 2005, Lin et al. 2012). The 'fuel' for cyclones is oceanic heat, so warmer temperatures logically result in stronger cyclones.

Figure 2. Tracks of all tropical cyclones in the Southwest Indian Ocean from 1980 to 2005. 90° E longitude is marked (vertical blue line) as this is the eastern boundary of the basin. The points show the locations of the storms at six-hourly intervals (Source: Wikimedia Commons [26]).

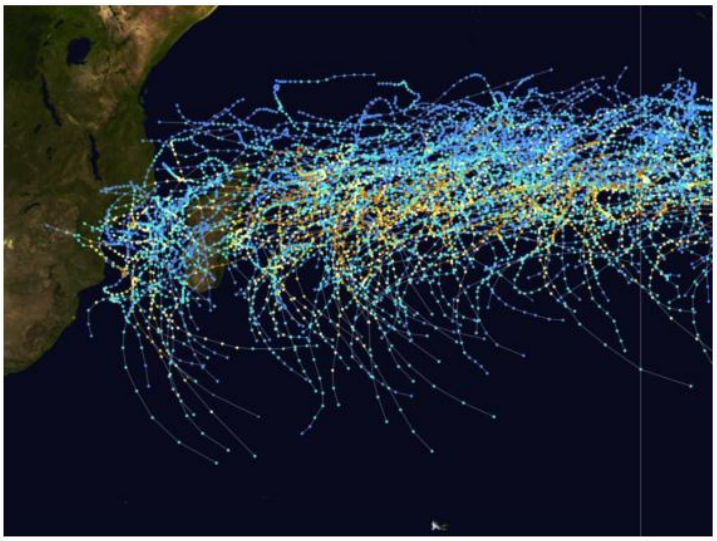

Image Reference: (Mather & Stretch 2012)

Locally, however, there may be even more cause for concern. What is often not discussed in the media is the body of scientific evidence suggesting the cyclone tracks will change as a result of climate change. This is because climate change causes large scale alterations in global circulation patterns, such that storm tracks are expanding poleward (Yin 2005, Rouault et al. 2010).

This phenomenon has already been observed. In a study by top climate scientists at the U.S. National Oceanic and Atmospheric Association, Massachusetts Institute of Technology, and Princeton University, records of cyclone paths over the past 30 years show a migration towards the poles, with the trend expected to continue as a result of climate change (Kossin et al. 2014). From the journal article:

> *In the Southern Hemisphere, both the South Pacific and South Indian Ocean regions contribute substantially to the poleward trend…Any related changes in positions where storms make landfall will have obvious effects on coastal residents and infrastructure.*

Higher frequencies and intensities of cyclones off the coast would further expose Durban to damage from high winds and elevated storm surge. This means the return period of extreme weather events will shorten (Hallegatte et al. 2010). A storm surge one might expect only once every 100 years will occur perhaps once every 50 or 75 years. The return periods used in the amended EIA failed to take into account this aspect. The amended EIA attempts to take into account elevated wind speeds by estimating they increase 10% by 2100, based on an outdated report that does not take into account regional climate models and the newest science [58].

Moreover, this change not addressed in the amended EIA could likewise affect coastal geography and local sedimentation and ocean transport characteristics. The modeling studies in the amended EIA addressing the viability of the expanded sandbank area did not take into account large scale disruptions in coastal dynamics and coastal sand distributions, and thus the stability of the sandbank construction comes into question.

A Modeling Study is Required to Address the Regional Characteristics and Varying Responses of Storm Surges to Climate Change and SLR

First, PRDW (2003) [59] data for calculating storm surge covers tide records only for 1972 to 2001. This does not include the 2007 tide records, during which the coastline and port were subject to massive flooding from offshore cyclones. Thus the ".69m for a 1:100 year storm surge event [59]" is likely an underestimate. We could also not find the PRDW (2003) article as it was missing from the references, and we would like the full dataset of tide records used in that study.

The EIA also assumes a 20% increase in storm surge [56], yet provides absolutely no reasoning or justification for this figure. As mentioned earlier, by carrying out a thorough climate-hydrological model and exploring the full multitude of parameters and potential scenarios (left out of the amended EIA), an actual projection can be made about storm surge instead of what appears to be a blind guess. Additional considerations not addressed in the EIA are the fact that SLR can have an indirect effect of changing storm surge propagation characteristics and can even "alter the tides by changing both dissipation and resonance effects," so calculations can not rely solely on historical data, but instead an actual modeling study (Lowe & Gregory 2005).

The amended EIA calculates that storm surge will increase from .690m to .759m by 2069 [57]. Despite the .690m figure for current conditions likely being an underestimate (see above), the .759m calculation is overly simplistic and ignores the complexity of projecting storm surge. The authors justify their calculation [59] by citing the US National Weather Service. They failed to include the actual reference, however, and after numerous searches we could not verify their formula. Regardless, numerous other studies mentioned below that estimate regional storm surge utilize complex hydrological models, suggesting a one-line calculation is far from sufficient and that the authors have not invested enough time and effort into developing their response.

Tidal effects are also assumed in the amended EIA to continue completely unchanged at 2.287m, an assumption that ignores a body of scientific evidence to the contrary. A 5% increase in tidal effects would lead to an 11cm rise based on the EIA measurements (and the 2069 freeboard is only 32cm). Ignoring this important variable represents an egregious lack of foresight.

Because all of the modeling and ecological assessments in the report rest on the parochial assumption that the circulation and seafloor/coastal structural patterns will persist into the future unaffected by such changes, we request a study to explore the impacts of climate change on changes to:

- Storm surge intensity and frequency
- Regional atmospheric and oceanic circulation
- Wind and ocean current direction and speed
- Cyclone intensity and frequency

Only when these are taken into account can the full array of scenarios be available for modeling the viability of the sandbank restoration and the safety and durability of susceptible infrastructure. The original request from the DEA: "A Climate Change Risk and Vulnerability Assessment to adequately address how sea level rise and coastal storm

surges will be addressed…" [76] clearly has not been sufficiently satisfied in this amended EIA.

Durban would be far from the first region/city to have the foresight to investigate these issues; modeling studies have been applied to a variety of coastal cities to better inform construction plans as well as adaptation and mitigation policies in the following areas:

- US coasts (Tebaldi et al. 2012)
- Copenhagen (Hallegatte et al. 2010)
- Bangladesh (Karim & Mimura 2008)
- New York City (Lin et al. 2012)
- United Kingdom (Lowe & Gregory 2005)
- And more… (see Tebaldi et al. 2012)

In Lin et al. (2012), researchers implemented a hurricane-hydrodynamic model "…to simulate large numbers of synthetic surge events under projected climates and assess surge threat…for New York City (NYC)." Their results were quite alarming, and a similar finding for Durban port would mean the '20% increase in storm surge' assumption used in the EIA drastically underestimates risk. The researchers found that a 1:100 storm surge event in NYC may instead occur every 3 to 20 years by the end of the century. Likewise, Tebaldi et al. (2012) found that along several regions of the US coastline, 1:100 water levels may become 1:10 water levels (a ten-fold increase in the likelihood of the extreme event).

Additional SLR Considerations Omitted from Amended EIA

Regional impacts of sea level rise are pertinent to discussions as well, given that sea level rise will not occur uniformly across the globe. Changes in ocean circulation and land subsidence can cause regional SLR much larger than the global average (Mitrovica et al. 2009, Tebaldi et al. 2012). The authors cite a study that analyzed historical data and showed local SLR was comparable to global SLR measurements from the 1970s to early 2000s. However, the study does not claim that this trend will continue into the future. To rule out regional variation, one cannot look at historical data alone but must also take into account additional localized factors that may arise as the rate of SLR accelerates.

Sea level rise will affect coastal dynamics, with elevated sea levels allowing increased wave energy into estuaries and thus harming sensitive mangrove habitat and altering

nutrient and sediment dynamics (Mather & Stretch 2012). Mather et al. (2012) also found that SLR will add to the water depth and thus increase wave energy both in and out of harbors, another aspect omitted from the amended EIA. The allowance for waves within the harbor should therefore be increased in addition to storm surge and overall sea level for future projections. This means the .324m freeboard calculated for 2069 is even more of an overestimate than what the amended EIA calculated. Mather et al. (2012) continued:

> *Within harbors, the extra water depth will result in less freeboard along the quayside resulting in more frequent wave wash/overspray onto the working area with increased down-time and loss of productivity. With the increased wave energy, ships moored alongside the quays will not be as stable as required for the offloading of cargo. This will result is longer off-loading times, longer ship turn-around times, inefficiency at the berth-side and extra costs.*

The amended report considers sea level rise in relation to the cope level and the possible erosion of the sand bank extension. It refers to hydrodynamic analysis in respect of the sand bank but does not address the concern that the deepening of the channel makes the bay more vulnerable to the effects of climate change. The hydrodynamic consequences of the wider and deeper of the channel extending from the mouth to berths 203-205 should be described.

Finally, the amended EIA acknowledges that climate change can impact currents [53], but any further mention of this is not included in the response. It fails to address the issue of altered current directions and intensities, an aspect that could significantly alter the biogeophysical characteristics of the port, including impacts on tides, sediment transport, and mangrove and sandbank habitats. A study by researchers from at University of Cape Town found that the Agulhas Current, responsible for the relatively warm ocean temperatures along the entire eastern coast of South Africa, has experienced significant warming in the past 30 years (Rouault et al. 2009). This is attributed to a shift of westerlies towards the poles induced by climate change (Rouault et al. 2009, 2010). This reinforces the idea that overall climate, wind patterns, and currents are all changing and that the risk analysis calculated in the amended EIA is far from sufficient in addressing these factors.

No Allowance for Natural Waves Occurring in the Port

The calculations of future CDP levels include a category named 'WAVE' that contributes .3m above CDP. However, this is the allotment for waves within the port caused by ships' wake effects [Feasibility Study 3, page 10]. In the event of extreme weather events, it is completely feasible for wind-driven waves to exceed .3m in amplitude. The calculations must take into account this effect, and the previously mentioned factor that storms and wind may increase in intensity in the coming years.

Extreme Rainfall Effects on Port Sedimentation

Andrew Mather, researcher for the eThekwini Municipality, suggests that increases in rainfall intensity will add to silt loading into the port, an aspect not addressed in the amended EIA. He classified sedimentation of the port as a 'high' concern, affecting utilization of the berths, navigation of the entrance channel, and overall shipping operations. He found that wave directions are of 'high' concern for these three key areas as well, and that recently these too have been changing (Mather 2011).

Ocean Acidification Effects on Sandbank Restoration and Mangroves

The amended EIA only considers ocean acidification's impact on the concrete structures. This directly avoids the most well-known impact of ocean acidification, which is the effect on aquatic organisms, aquatic chemistry, and overall habitats. The sandbank extension depends on the reintroduction of native plants and other organisms. With oceans becoming nearly 30% more acidic in the past 150 years—and that rate projected to increase—it is essential that the report addresses the impacts of increased acidity on organisms in the Port so that the sandbank extension's success is ensured (Doney et al. 2012). Combined with stresses of rising temperatures and turbidity, another aspect not addressed in the amended EIA, these changes in seawater properties can severely stress organisms. Additionally, ocean acidity has complex secondary effects such as altered seawater chemistry and increased nitrogen fixation rates because more acidic environments can allow chemical reactions to occur that were not previously possible (Doney et al. 2009).

General comments:

- The biological importance of certain habitats to populations of endangered species including birds, chameleons and frogs. Within the Bay a mere 14% of the tidal flats remain, yet the sandbanks provide the only sheltered, marine dominated, permanent tidal sandbank habitat in KZN. Thirty species of fish and sand prawns are found here and 132 species of birds frequent the area. Despite the marine traffic, the central sandbank and mangroves remain an important nursery area for young fish. Sixty-two endangered, migratory species (in particular waders) rest and feed here. Under the Bonn Convention on the Conservation of Migratory Species of Wild Animals, to which South Africa is a signatory, South Africa is bound to protect these birds and thus the habitat on which they rely. Durban Bay is one of few such habitats on the sub-tropical east coast of Africa. The Bay is only one of three such habitats on the south-eastern African coast. Due to the above reasons we feel as if the importance and significance of the Sandbanks are not presented equitably and completely compromised for convenience in light of this development.

- Transnet's own Draft Estuarine Management Plan (March 2012) points out that Durban Bay's estuarine ecosystem has been compromised to the point that it has lost resilience. The study emphasises the critical need to protect and enhance the existing estuarine habitats and stabilise the environments within the Bay over the next five year period. Existing and new developments within the catchment of the Bay have cumulative impacts on the bay ecosystem, which are increasingly compromising the integrity of the bay and pushing it to the brink of collapse. This is justification on the stress of the importance and significance of the Sandbanks and ecosystems. Preservation of the Sandbanks and ecosystem in the bay should be paramount and not be pushed for further development which causes the further destruction.

- Referring to the statement made on page VI in the executive summary of this document: "The biggest socio-economic impact of this loss will related to recreational and subsistence fishing (due to the loss of nursery habitat), however it should be noted that the central sandbank extension will increase nursery habitat and thus will have a positive socio- economic impact on this regard".- we disagree with this statement as we feel not much research and investigation has been done to consider the KZN Subsistence Fishermen Forum who solely rely on subsistence fishing as a means of their livelihoods. This development threatens their livelihood activities and further food security.

- In regards to the mitigation measures this document presents, it is very weak in the presence of the impact this development.

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