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Weather-related hazards put R20bn worth of CoCT's transport infrastructure at high risk – analysis shows

Severe weather events can wreak havoc in urban environments, and the City of Cape Town (CoCT) is no exception. In a paper published in the *Journal of the South African Institution of Civil Engineering*, the University of Cape Town (UCT) researchers quantified the volume of transport infrastructure at risk of weather-related hazards in the CoCT and estimated the direct economic value.

Dr Tanya Lane-Visser and Professor Marianne Vanderschuren of the UCT Centre of Transport Studies in the Department of Civil Engineering conducted the analysis, which revealed that the city's transport infrastructure is valued at R20 billion and is at high risk due to coastal flooding and fires.

"Transportation is both directly and indirectly vulnerable to weather and climate impacts. Direct vulnerabilities consist of impacts on physical infrastructure and non-physical impacts on human health, behaviour, and decision-making. Indirect vulnerabilities result from transport's interaction with and dependence on other critical infrastructure and social systems, including water, electricity, information and communication and petroleum systems," said Lane-Visser.

Lane-Visser said there were four key climate change challenges confronting the city: decreased annual average rainfall and a change in the seasonality of rainfall; increased mean annual temperatures with higher maximum temperatures (more hot days and more frequent and intense heatwaves); increased average wind strength; increased intensity and frequency of storms, leading to short, high-intensity rainfall events; and increased size and duration of coastal storms. Sea level rise will, additionally, continue to occur.

This analysis aimed to uncover the extent to which transportation infrastructure in the CoCT is exposed to climate-related hazards. A geographic information system (GIS) based analysis was done to calculate the quantum of transport and socio-economic infrastructure at risk. The results of this analysis were used as inputs for an economic risk analysis, where the value of the transport and socio-economic infrastructure at risk was estimated. The scope of the analysis was restricted geographically to the city limits and only included passenger transport. Spatial data on the CoCT's road network (distinguishing between national and urban roads), minibus taxi routes, stops and ranks, bus rapid transit (MyCiti) trunk and feeder routes, MyCiti trunk stations and feeder stops, regular bus routes operated by Golden

Arrow Bus Services (GABS), GABS stops, and the city's railway lines, and railway stations were included.

In 2019, OneWorld calculated the total exposure per major suburb in Cape Town as the weighted sum of the following hazards: extreme rainfall days, fire risk areas, fire incidence, heat islands, high fire risk days, inland flood frequency, maximum temperature, and mean temperature increase, very hot days, average windspeed, sea-level rise inundation risk, and rainfall change percentage. The various transport and socio-economic infrastructure layers were overlaid, and the areas of intersection were determined. The quantum of infrastructure within the intersection areas was calculated to represent the transport infrastructure at high risk.

Lane-Visser said: "Some 24% of all roads within the city fall in the high exposure areas and are, therefore, deemed at risk of damage or destruction due to adverse climate impacts. Even more concerning is that more than half (52.6%) of all moderately sized taxi ranks in the city are in these high-risk zones. Additionally, 13.6% of MyCiti stops and stations and 23% of GABS bus stops are highly exposed, while a third of all rail stations and 23% of railway tracks are located in high-risk areas. A low percentage of the national roads within the CoCT limits run through high-risk areas (6%)."

In addition to this analysis, Lane-Visser said three specific climate-related hazards (coastal flooding, flooding of low-lying areas and fire vulnerability) were modelled individually to highlight their relative risk contributions and the geographical differences between their impacts.

"Almost 27% of minibus taxi routes and 35% of their daily stops lie in high-risk areas. Adverse weather can, thus, cause massive disruption to almost a third of taxi routes in the city. The MyCiti network utilises large portions of the coastline on the Atlantis corridor, yielding around 15% of the network at risk of coastal flooding. The biggest threat to GABS is the threats affecting the suburbs that the buses pass through.

"Quantifying the potential socio-economic impacts of climate-related hazards in the CoCT, a staggering 79.6% of Capetonians reside in high-risk areas. Some 45.5% of the population live in areas at high risk of flooding and a further 11% will be exposed to extreme cases of flooding. Coastal flooding events could impact as much as 28.9% of the population. Employment levels are highly correlated to that of the population and adverse weather can potentially negatively impact as much as 50% to 80% of the city's labour force. The analysis showed that 15.2% of the city's schools and 28.8% of healthcare facilities are in high-exposure areas. Extreme weather events can, thus, have a substantial impact on access to healthcare and, to a lesser extent, education opportunities in Cape Town," she said.

It is estimated that in high-exposure areas, road infrastructure damage alone could potentially amount to between R4.6 billion (US$250 million) and R12.1 billion (US$670 million). These values include both urban and national roads. "Accounting for the fact that national infrastructure falls under the purview of the provincial and national government, the city could still be facing a repair bill of between R4.1 billion (US$230 million) and R9.3 billion (US$520 million) for its urban roads," said Lane-Visser.

Professor Vanderschuren, South Africa's leading transport expert, said the greatest hazard threatening the MyCiti bus rapid transit is coastal flooding, due to the geographical location of the current network. "A total of R3.26 billion (US$180 million) worth of BRT infrastructure

is at risk. A total of 30 of the 57 taxi ranks in the analysis lie within high exposure areas of the city, including the Bellville Station super major taxi rank (with more than 35 000 daily departing passengers)," she said.

Transport infrastructure worth R392 million (US$21.73 million) is extremely exposed to climate-related weather events, being located in areas that could be affected by multiple climate hazards. In total, around R20 billion's (US$1.11 billion) transport infrastructure is in the predefined high-risk areas and, as such, is subject to significant weather-related damage. Infrastructure traversing the Paarden Eiland/Maitland/Brooklyn and Strand areas is the most exposed to climate-related hazards and deserve special caution.

According to Vanderschuren, proofing and maintaining infrastructure, adding new infrastructure and developing appropriate response strategies are all prudent governance tasks that can minimise the risk that severe climate events pose to transportation systems. Investing in fire safety protocols and disaster response plans will benefit the CoCT. "Raised infrastructure can substantially decrease the threat that flooding of low-lying areas poses to transport mobility," she said.

Vanderschuren said the CoCT could use the outputs from this analysis to identify and develop custom mitigation plans for critical infrastructure elements. "It is evident that spatial planning cognisant of weather-related hazards can play a major part in reducing climate-related risks to transport infrastructure. Similar studies in other cities are suggested to increase climate readiness," concluded Vanderschuren.

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