ICAO – ACI Master Planning Seminar, 29 – 30 June 2023
Technical Session 2: Airport Climate Change Resilience and Airport Innovation

Preparing Changi Airport for Climate Change

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CHANGI airport group

Singapore adopts a whole-of-government approach to strategise climate change responses

Under auspices of the Resilience Working Group, studies on impact of climate change were conducted to align scenario planning parameters and coordinate actions for deliberation and decision-making to safeguard the population, environment and critical infrastructure, such as airports, in the most effective and efficient manner

Singapore projected to see extreme sea levels by the year 2100
Source: YouTube, 15 Jul 2022

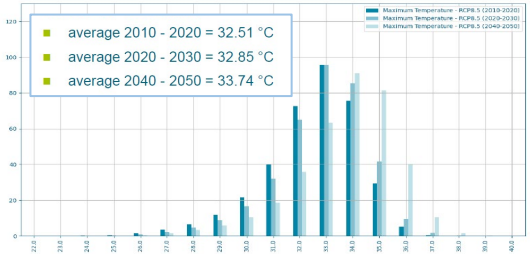
Heatwaves in Asia becoming more frequent and intense
Source: YouTube, 22 Jun 2023

- Strategy Group, Prime Minister's Office
- Ministry of National Development
- Civil Aviation Authority of Singapore
- National Environment Agency
- Ministry of Environment and Water Resources
- PUB, The National Water Agency
- Building and Construction Authority
- Changi Airport Group
- Resilience Working Group

Identifying airport vulnerabilities

Studied near-term (2030) and longer-term (2050 and beyond) impact of climate change on airport operations

Vulnerabilities for follow-up action	Other risks assessed as tolerable
1) Lightning hazards delaying aircraft operation	1) Storage tanks at fuel farm can tolerate projected wind speeds
2) Lightning hazards affecting jet fuel jetty off-loading operation	2) Aerobridges may have to be tied down and not used during high wind speeds
3) Increasing temperatures causing heat stress for airside workers	3) Building chiller plants are designed with buffer capacity to cater for higher ambient temperatures
4) Increasing temperatures weakening aircraft pavement structure	4) Runway lengths are adequate to support most demanding aircraft take-off distance under higher temperatures
5) Higher intensity rainfall affecting runway friction during stormy weather	5) Jet fuel expansion needs and safe storage temperature are sufficiently catered for despite rising temperatures
6) Higher intensity rainfall and rising sea levels causing flooding of runways, taxiways and aprons	6) Ground structures are designed to resist buoyancy due to higher ground water table
7) Higher intensity rainfall and rising sea levels causing localised flooding and damaging critical infrastructure	7) Revised standards for development platform level and drain capacity designs to accommodate higher rainfall intensity and rising tide levels



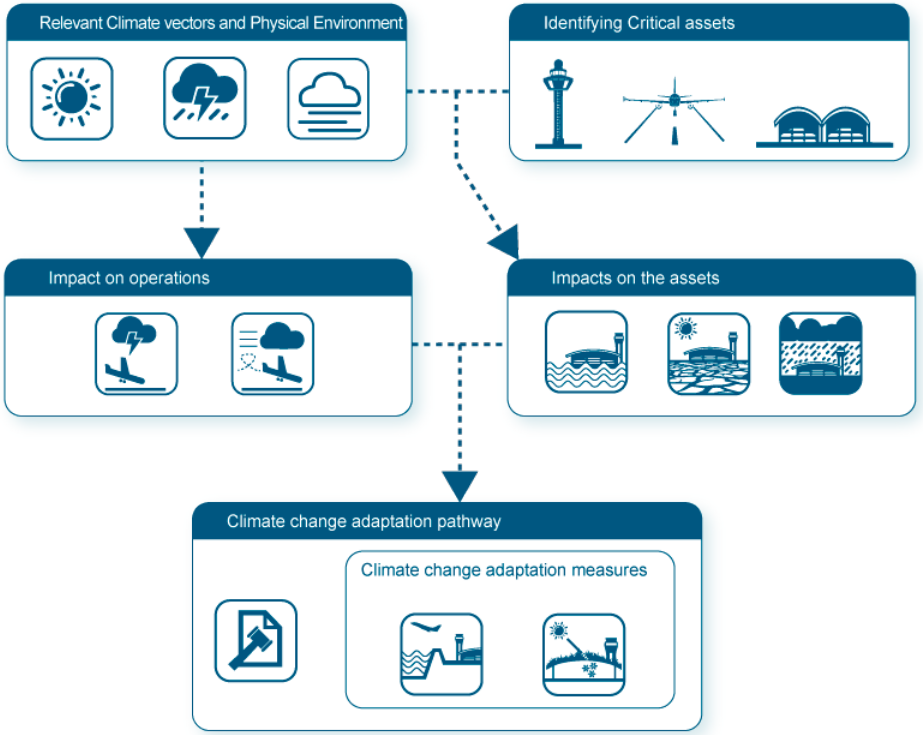
Parameters	Historical High	Near Term 2030 Projection	Medium Term 2050 Projection
Rainfall (60-minute total)	**147 mm** Changi 2 Nov 1995	**175.5 mm** (derived from PUB's COP value of 130 mm, with an added 35%)	**195 mm** (derived from PUB's COP value of 130 mm, with an added 50%)
Sea Level	**101.877 mRL** (converted from 3.59m tide) CAFHI 24 Dec 1999 0012h **101.854 mRL** (converted from 3.42m tide) Tn Merah 23 Dec 1999 1042h	**102.77 mRL** (1-in-1,000 year sea level from BCA's Coastal Inundation Risk Map Study for Singapore 2013)	**103.45 mRL** (1-in-10,000 year sea level from BCA's Coastal Inundation Risk Map Study for Singapore 2013)

Source: Met Service SG (rainfall historical high); MPA (sea level historical high); PUB (rainfall projection); BCA (sea level projection)

Managing key climate vectors

Tackling the risk factors below through a systematic approach

- Rise in sea level
- Increased rainfall intensity
- Increased lightning frequency
- Increased air temperature

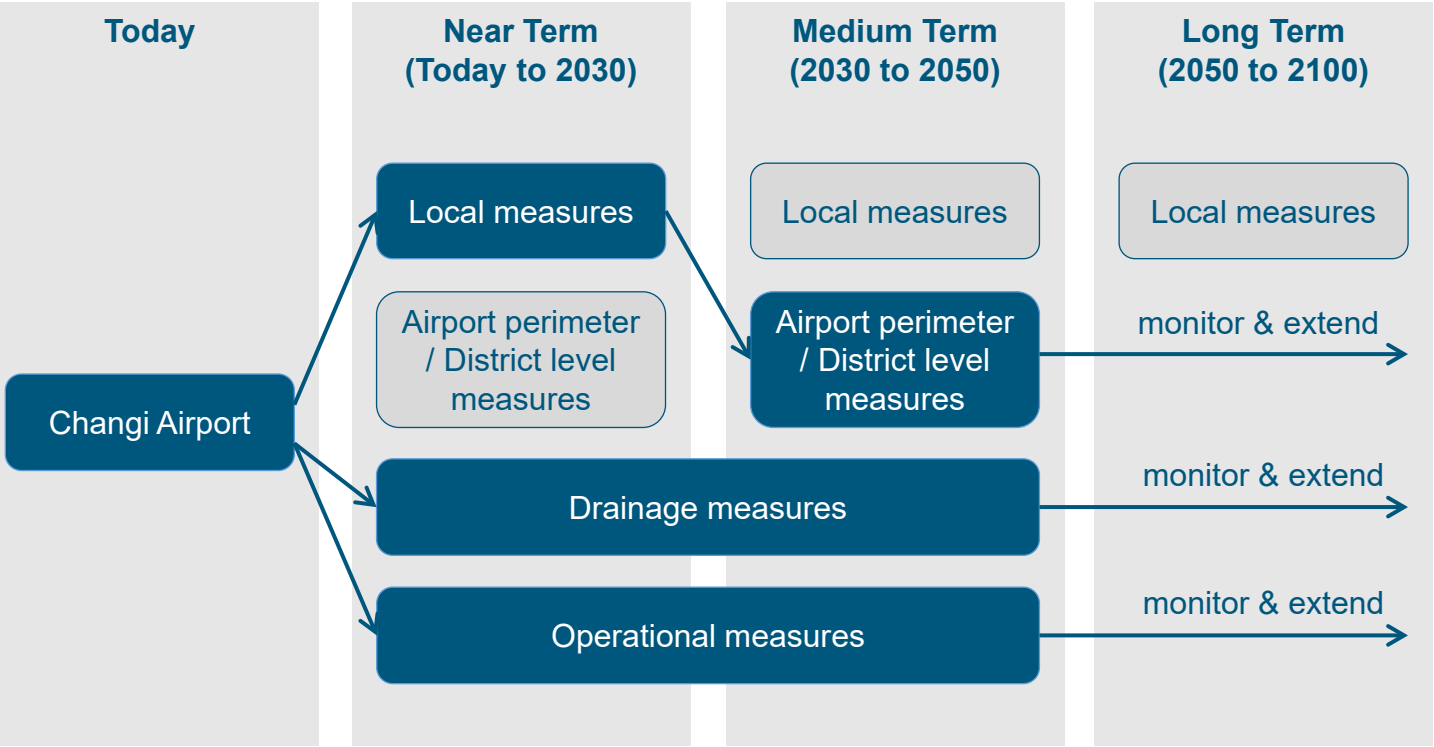


Adaptation pathways

Takes into consideration the following attributes:

- *Long-term outlook*
- *Incremental and non-abortive measures in tandem with changing risks*
- *Flexibility to accommodate periodic re-evaluation of mitigation measures*

Recommended pathways



District level intervention

As part of the National Coastal Protection Master Plan, the roads north of Changi Airport are constructed at higher elevation level to serve as a levee to protect against rising sea level in the longer term

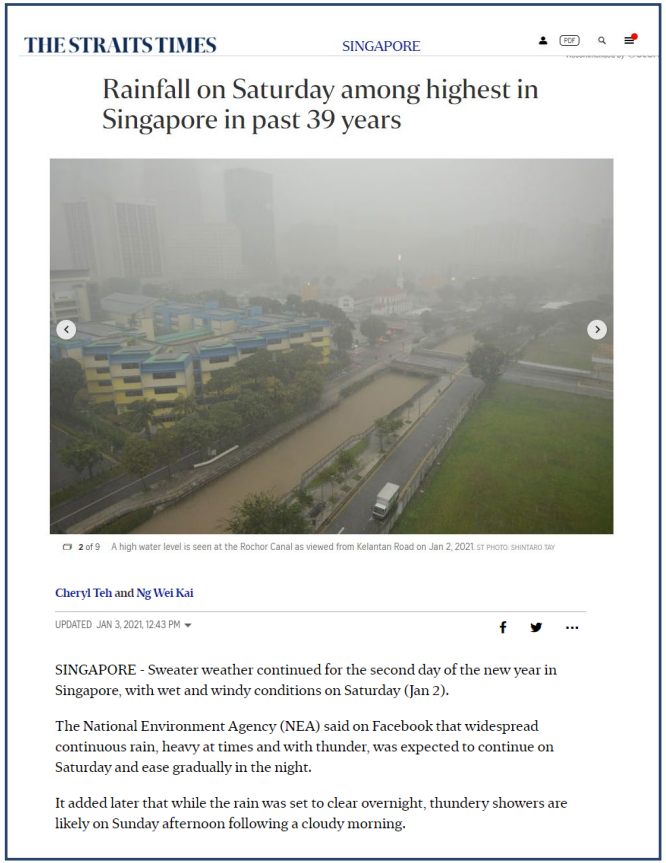
The 1km stretch of Nicoll Drive, which hugs the shoreline near Changi Beach, was raised by 0.8m in 2016 to clear the projected 0.76m rise in sea level by 2100

Local measures

2 **Moveable flood barrier around HF receiving station antenna farm**

1 **Fixed flood barrier around sunken ILS Glide Path building**

Managing flooding risks



THE STRAITS TIMES SINGAPORE

Rainfall on Saturday among highest in Singapore in past 39 years

2 of 9 A high water level is seen at the Rochor Canal as viewed from Kelantan Road on Jan 2, 2021. ST PHOTO: SHINTARO TAY

Cheryl Teh and Ng Wei Kai

UPDATED JAN 3, 2021, 12:43 PM

SINGAPORE - Sweater weather continued for the second day of the new year in Singapore, with wet and windy conditions on Saturday (Jan 2).

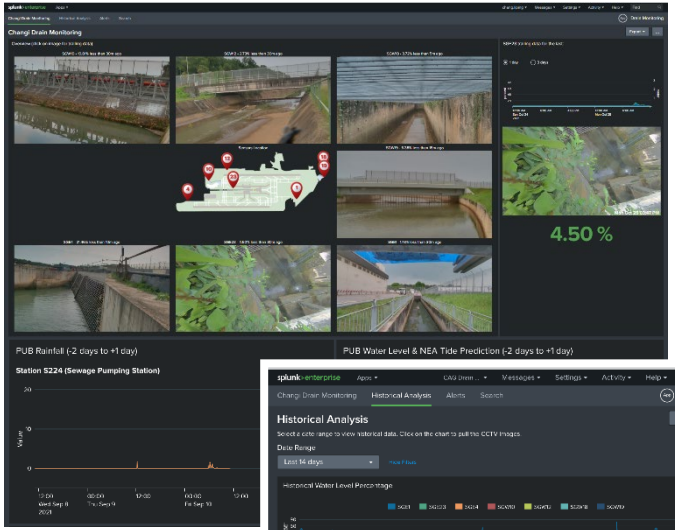
The National Environment Agency (NEA) said on Facebook that widespread continuous rain, heavy at times and with thunder, was expected to continue on Saturday and ease gradually in the night.

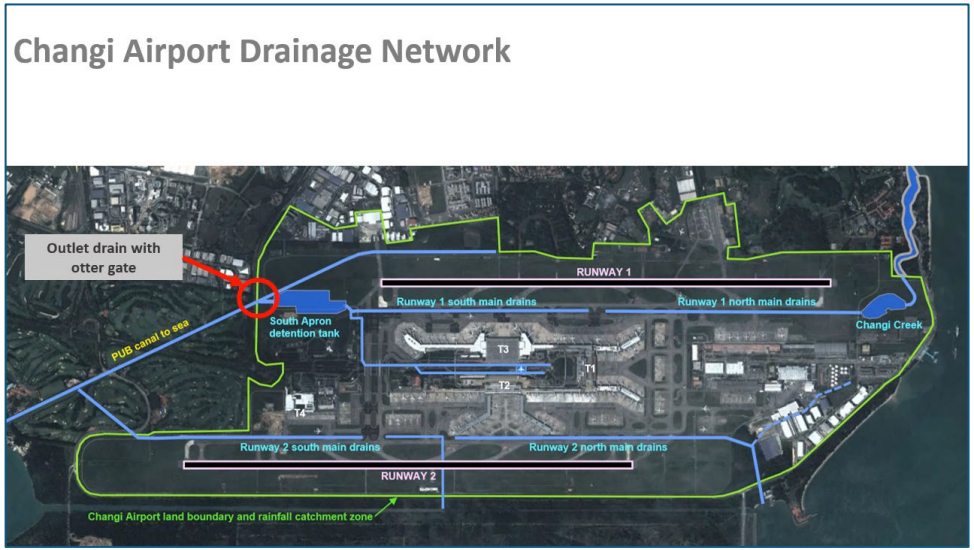
It added later that while the rain was set to clear overnight, thundery showers are likely on Sunday afternoon following a cloudy morning.

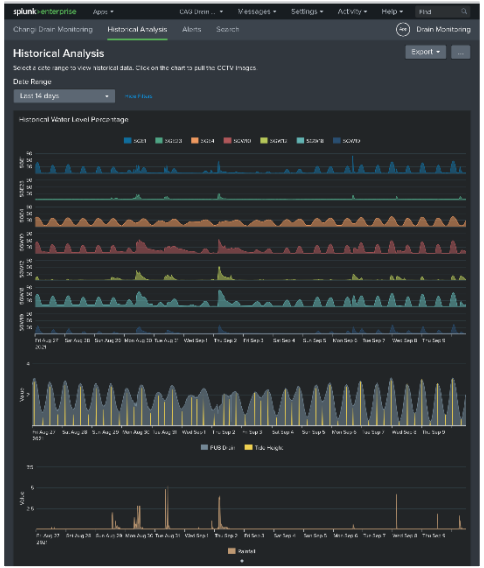
10m-deep rain water detention tank coupled with expanded drains built to coordinate flood protection scheme with airport hinterland through withholding 1-in-100 year storm catchment and only discharging storm water to external drains vide sluice gates and pumps during low tide and after rain has stopped

Managing flooding risks

Deploying smart iOT sensors to trend drain water levels overlaid with predictive algorithms to provide early warning of flood risks





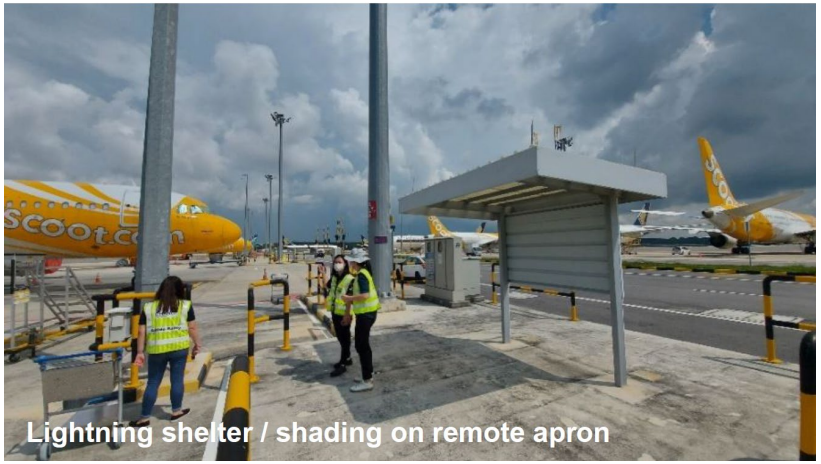


Managing higher rainfall intensity and lightning frequency risks

Improved runway drainage and friction to mitigate risks of aqua-planning by implementing trapezoidal grooves on pavement

Studying the use of tethered drones to shield parked aircraft on ground from lightning strikes so as to protect ground staff from hazardous shocks and allow continuity of operations in all-weather conditions

Managing effects of higher ambient temperature



Lightning shelter / shading on remote apron

Rutting

Avoiding heat stress and fatigue under heat

Studying relationship between ambient temperature and pavement temperature built-up

Where there are challenges, there are also opportunities

Exploring the deployment of frangible and non-glare solar panels in the open airfield outside runway and taxiway graded strips to harness renewable energy for airport operation to cut carbon footprint


Thank you.