

Real-time tropical cyclone data used to understand impacts

Surface Weather Information Relay and Logging Network

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Australian Government
Australian Reinsurance Pool Corporation



SWIRLnet

Surface Weather Information Relay and Logging network

Portable anemometer network for measuring wind speeds of tropical cyclones that impact the communities where we live



So...

Why are we wanting to measure wind speeds?

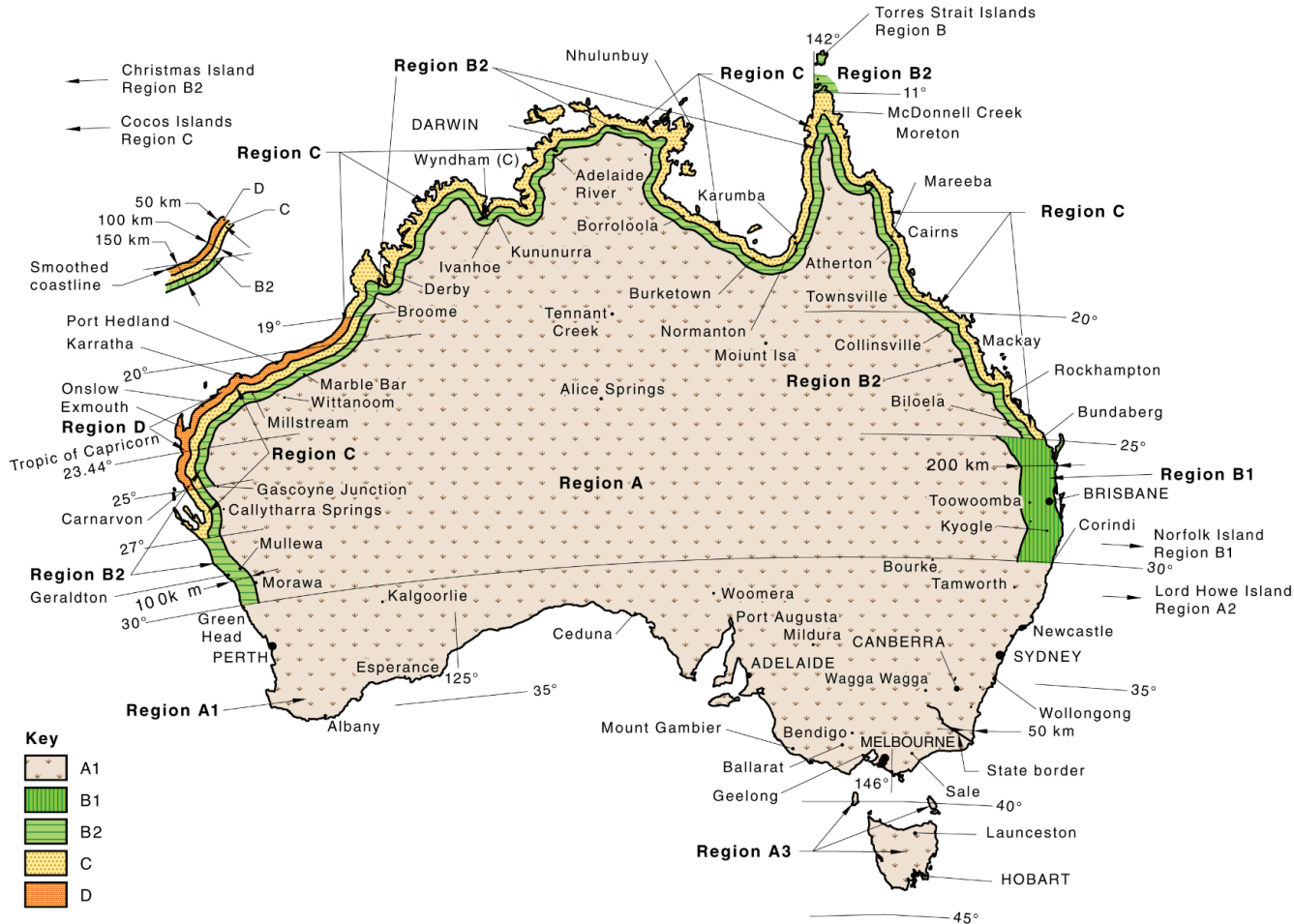
NCC Structural Tenents

- Safeguard people from injury caused by structural failure,
- Safeguard people from loss of amenity caused by structural behaviour,
- Protect other property from physical damage caused by structural failure

Minimum design standards

NCC: Class 2 Importance level
1:500 Annual probability of exceedance
 or
10% in 50 yrs prob of exceedance

AS/NZS 1170.2

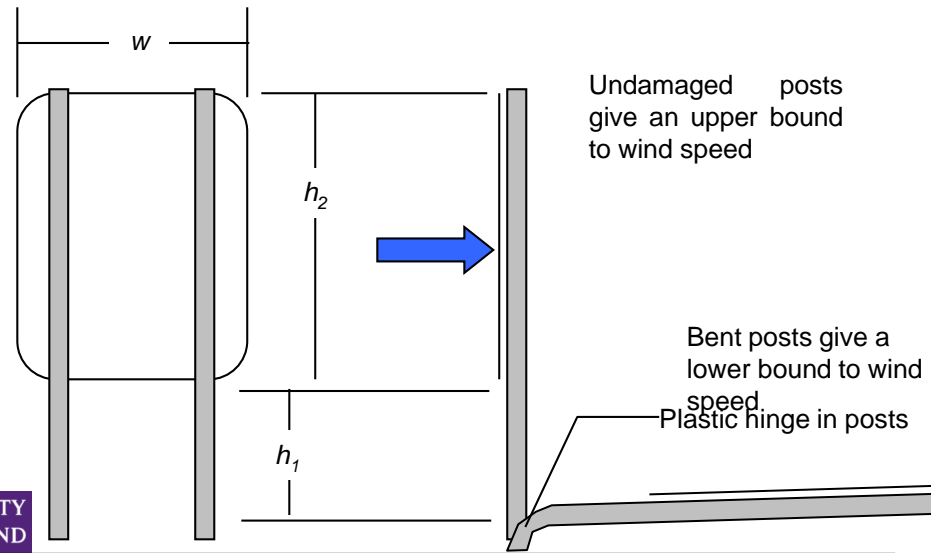


Then why failures?

- Are our design standards appropriate?
- Was the design criteria (wind speed) exceeded?
- Correct implementation of design criteria?
- Appropriate materials?
- Adequate construction quality?



How do we get these all important wind speeds?

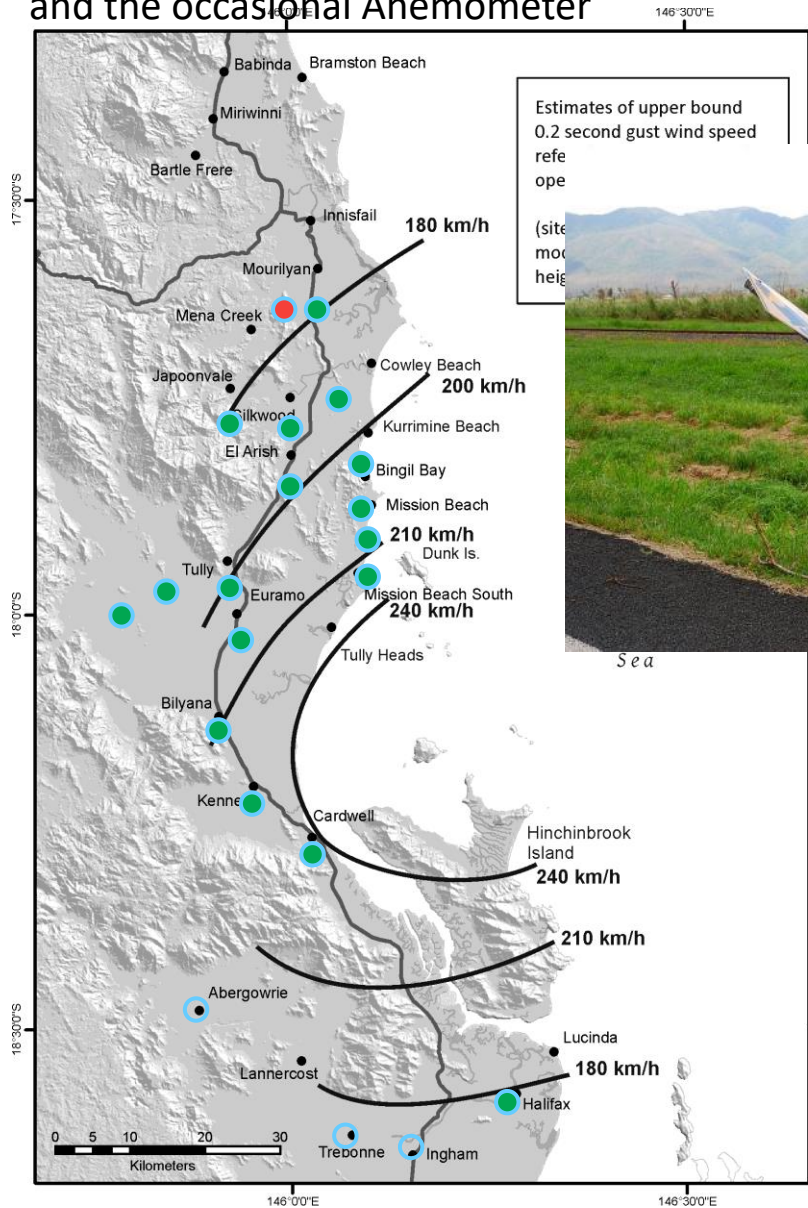


150 to 300 km between usable anemometers

Wind speed estimated from numerical models, street sign data and the occasional Anemometer

“Less than 2% of the peak wind speeds of cyclones making landfall in Australia have crossed where there is a capability to measure them”
Harper et al 2008

TC Yasi (2011)



So, for the last 20+ years of damage surveys following damaging cyclones; There have been limited usable anemometers in the region

- Have relied on “signs” to help with the wind field models

SWIRLnet

- Aims
 - Capture high-fidelity records of near-surface wind fields during landfalling tropical cyclones in Qld
 - Complement existing fixed anemometer network with real-time information relayed to end-users
 - **Science:** Study the structure of the tropical cyclone boundary layer in and around built up areas
 - **Engineering:** Inform damage assessment, vulnerability models, building codes and standards
- History
 - Conceptualised, seed funding sourced (Qld Govt., CTS at JCU, Risk Frontiers)
 - System build at CTS, JCU in 2012
 - First (real) deployment in 2014 (TC Dylan in Cooktown)
- Target
 - Anemometers to be located in/close to communities (towns)
 - Plan for deployment in the 48 to 24 hr period before landfall (only one “highway” for tropical east coast and that can flood)



Surface Weather Information Relay and Logging Network (SWIRLnet)



RM Young prop anemometer

3.0 m high re-locatable tripod

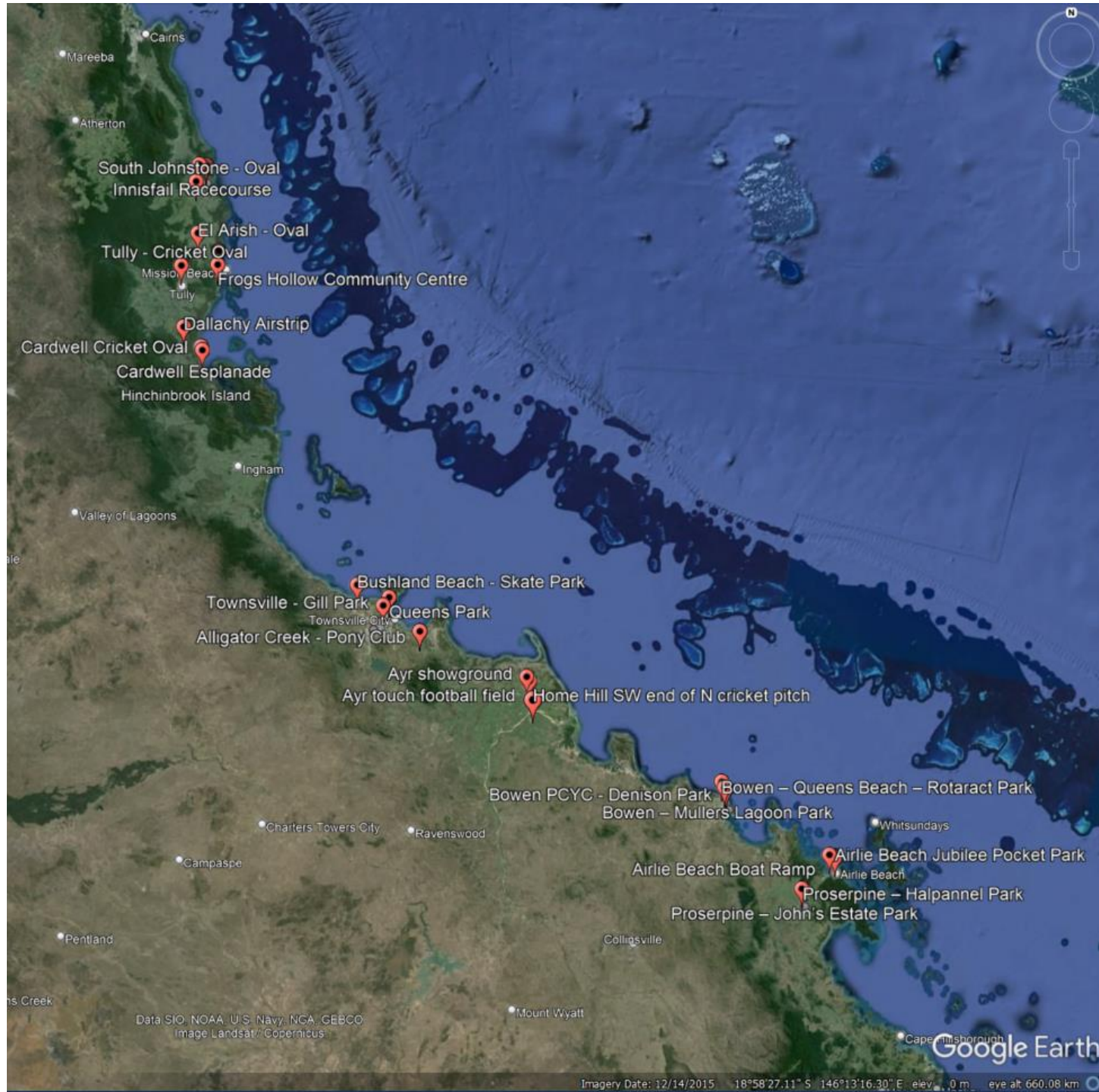
Load tested – static point loads

Guy wires to limit mast deflection

Data logger recording to CF memory card and 10 minute summary sent via 3G modem (wind speed and pressure)

Hold down:

- Permanent buried concrete anchor for prearranged sites (**Great cooperation from local councils!!**)
- Helical ground screws and stakes for opportunistic sites



23 permanent anchor sites

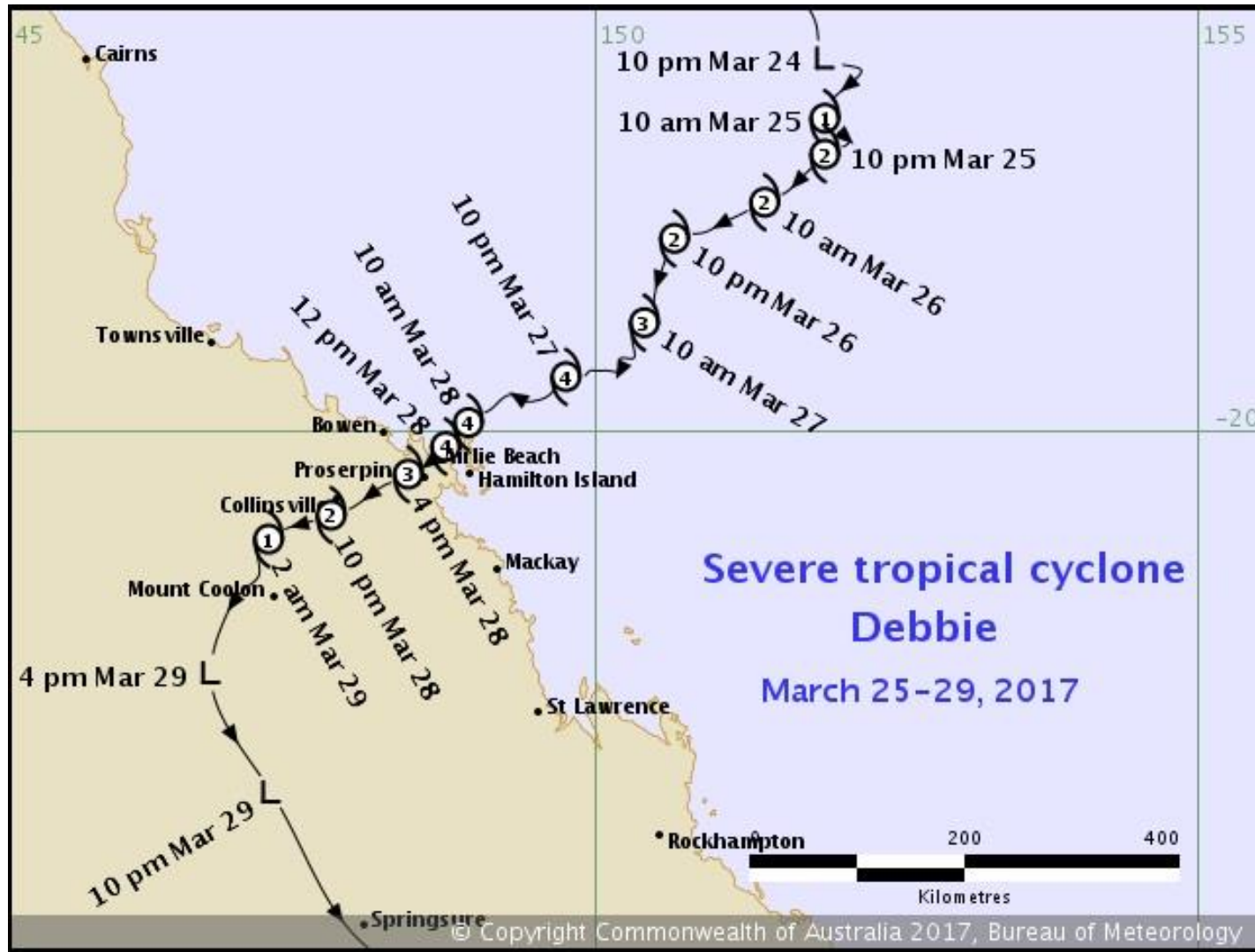
From Proserpine to Innisfail

Require screw in removable ground anchors for where we don't have concrete anchors

Take 30 to 50 minutes to install depending on soil type



Installed anchor during load test





(a) Tower installed before cyclone



(b) Dismantling tower after cyclone

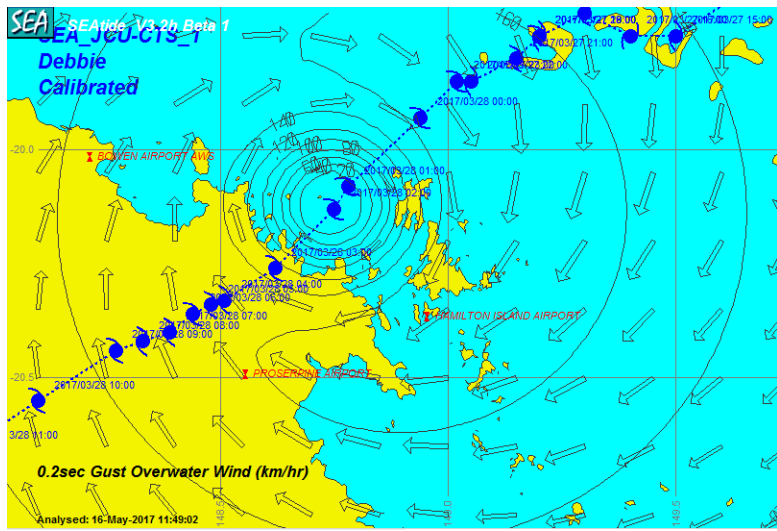
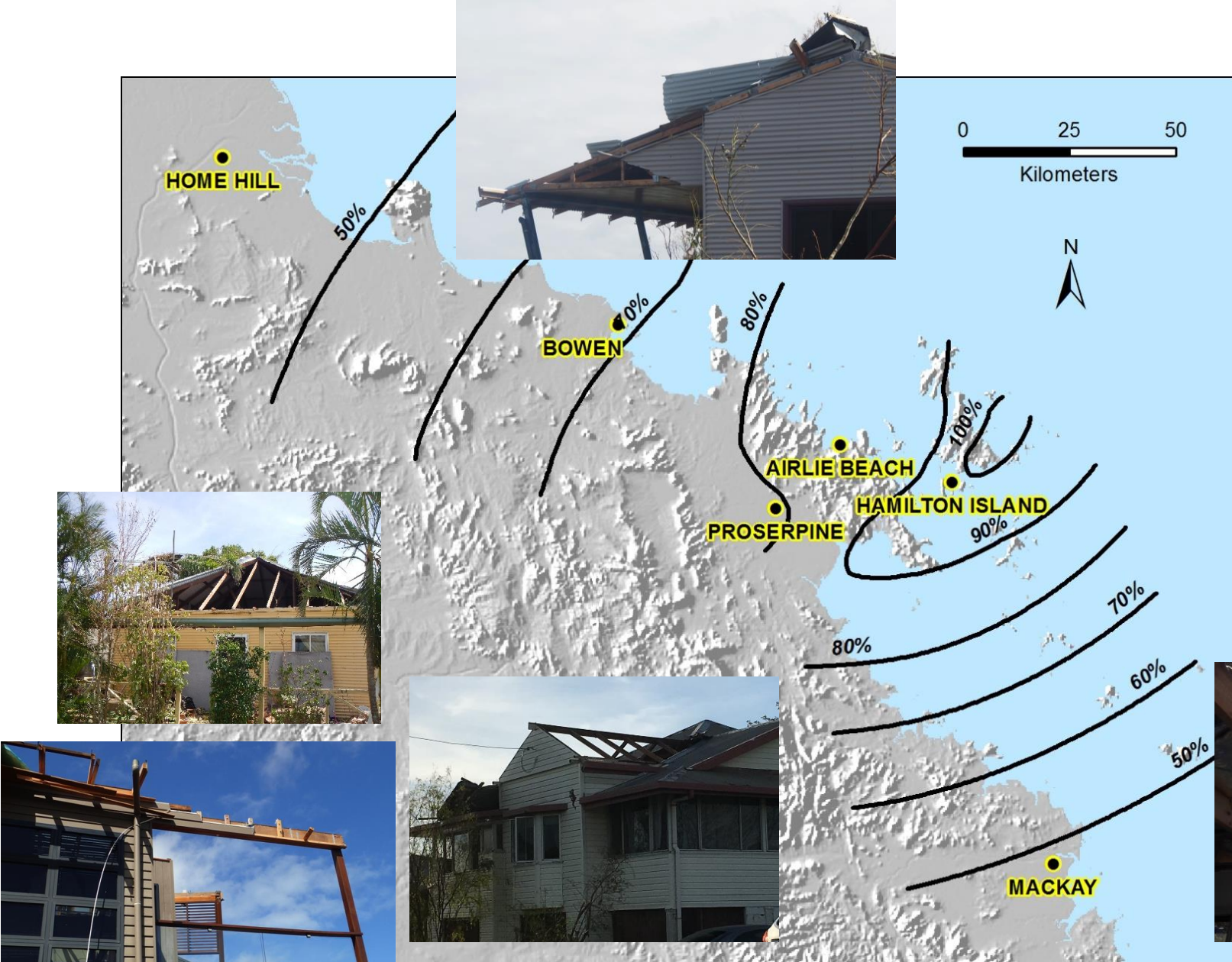


Table 2.3 Adjusted anemometer data as a percentage of V_{500}

		$\hat{u}_{3,600,tower}$ @ 3.2m [m/s]	$\hat{u}_{3,600,open}$ @ 10m [m/s]	$\hat{u}_{0.2,600,open}$ @ 10m [m/s]	% V_{500}
BoM AWS (z = 10 m)					
	Bowen Airport	41.1	41.5	47.6	69
	Proserpine	45.8	47.2	53.5	77
	Hamilton Island	73.1	57.3	67.1	97
	Mackay Met. Office	26.4	24.0	26.6	38
	Mackay Airport	27.2	27.9	31.5	45
SWIRLnet	Location	$\hat{u}_{3,600,tower}$ @ 3.2m [m/s]	$\hat{u}_{3,600,open}$ @ 10m [m/s]	$\hat{u}_{0.2,600,open}$ @ 10m [m/s]	% V_{500}
Tower (z = 3.2 m)					
1	North Ayr	16.5	20.6	22.4	32
2	North Bowen	30.3	37.9	41.9	61
3	South Ayr	15.4	19.5	21.3	31
4	Home Hill	17.7	21.2	23.7	34
5	South Bowen	34.9	42.6	47.6	69
6	Proserpine	27.0	36.4	49.6	72

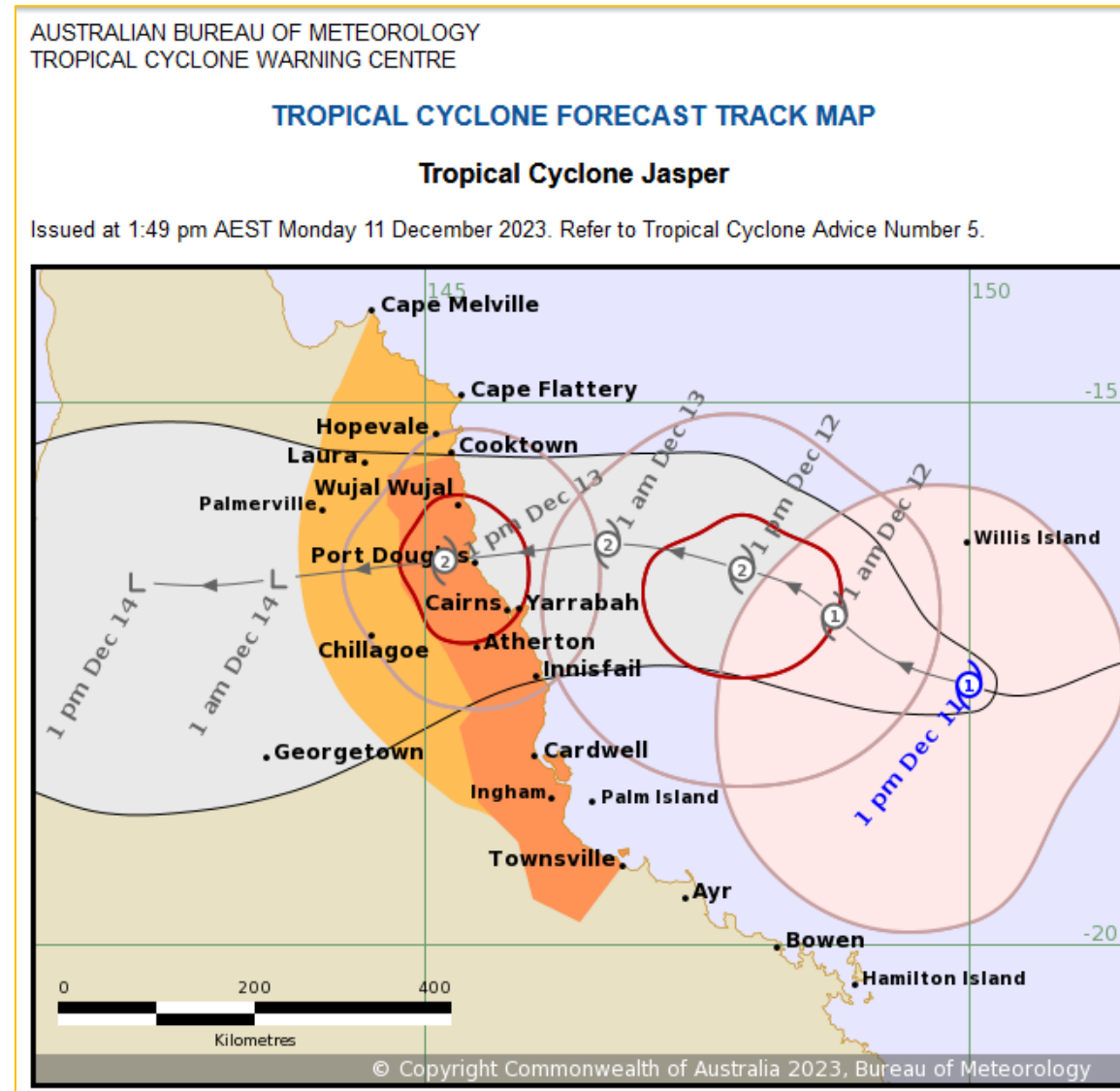
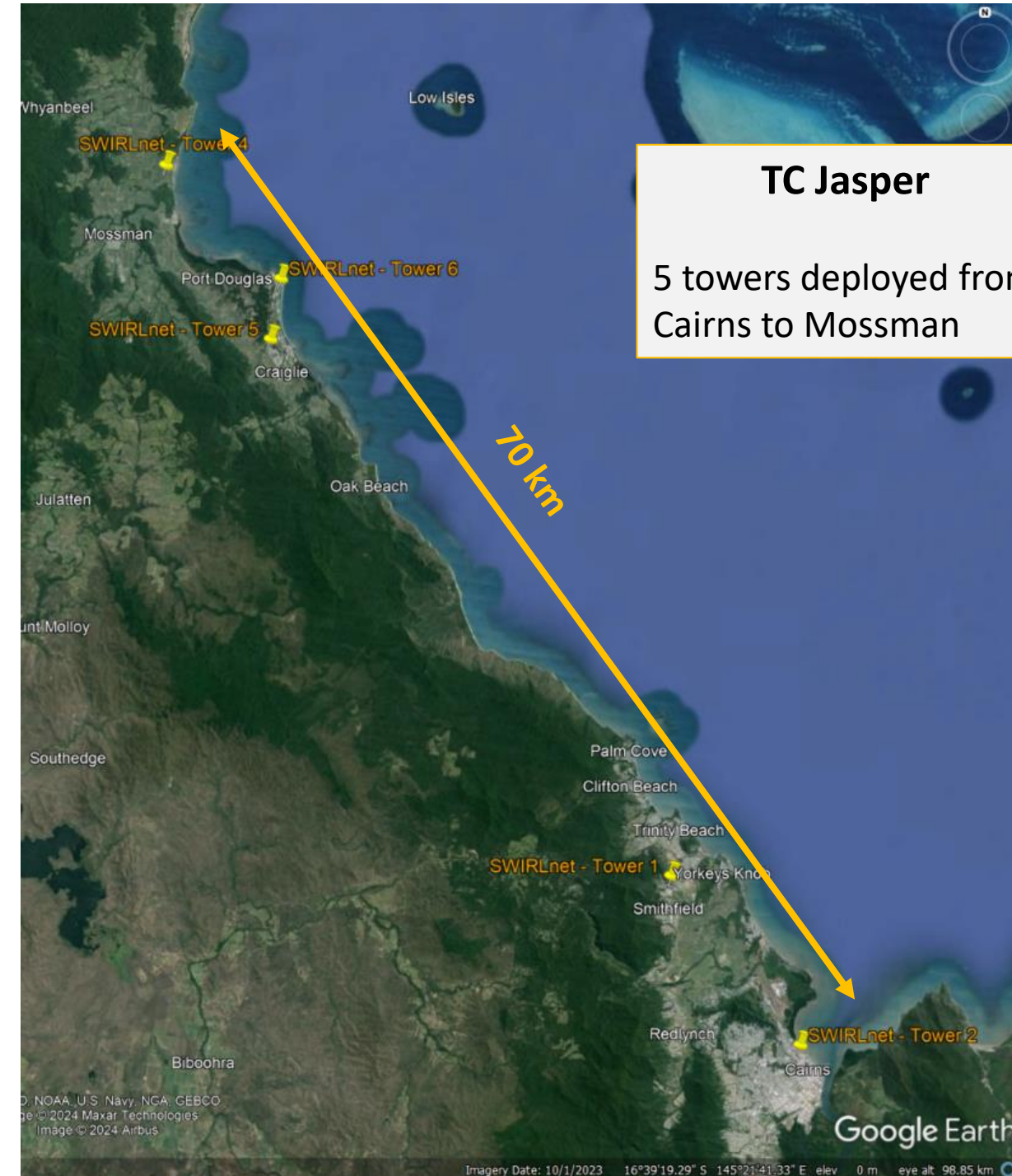


STC Debbie (2017)

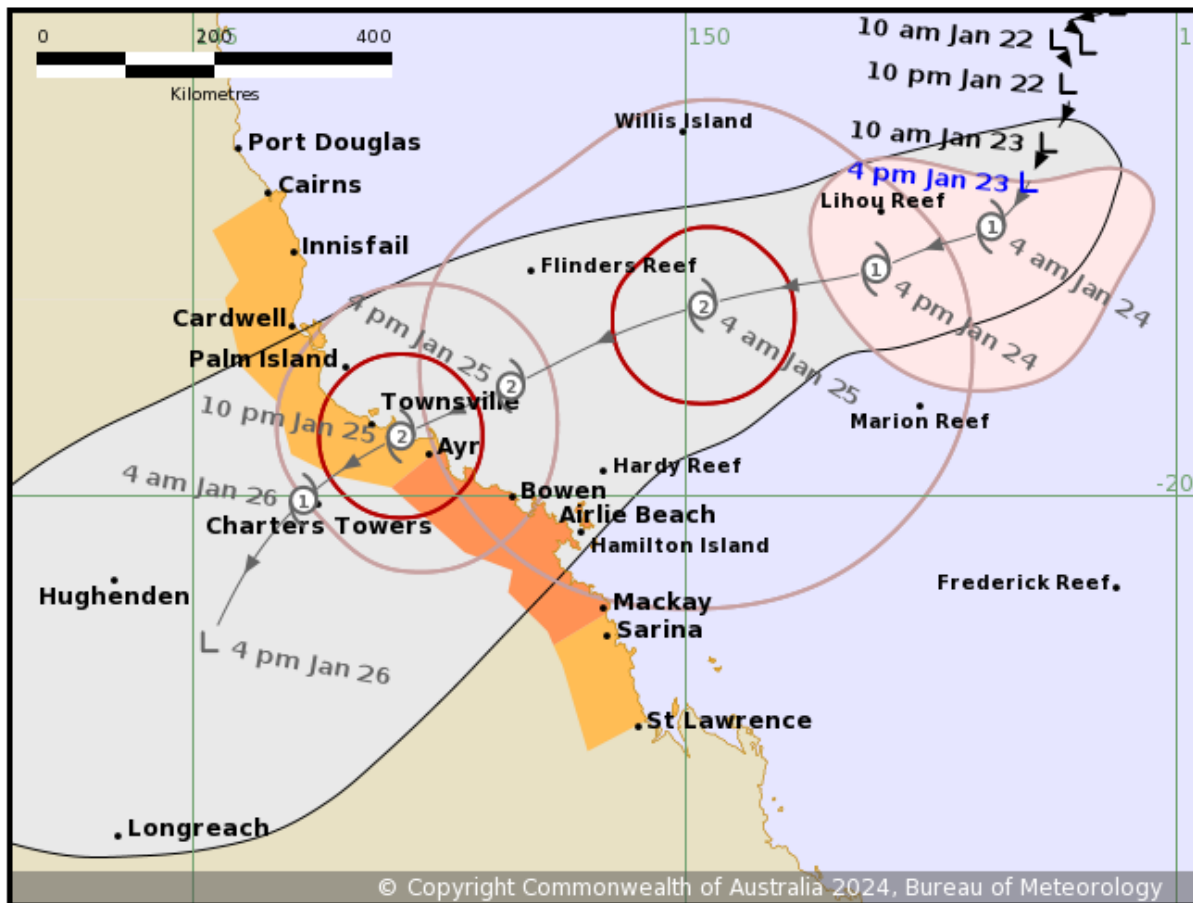
Estimate of wind speed as a % of Design (V_{500})

(referenced to 10 m height in open terrain)

Wind at specific buildings influenced by surrounding hills/shielding/exposure

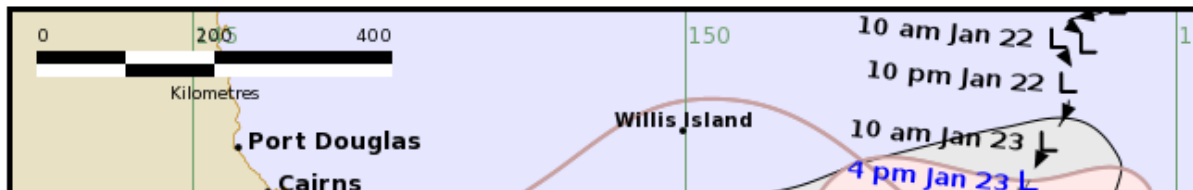


Issued at 4:54 pm AEST Tuesday 23 January 2024. Refer to Tropical Cyclone Advice Number 7.

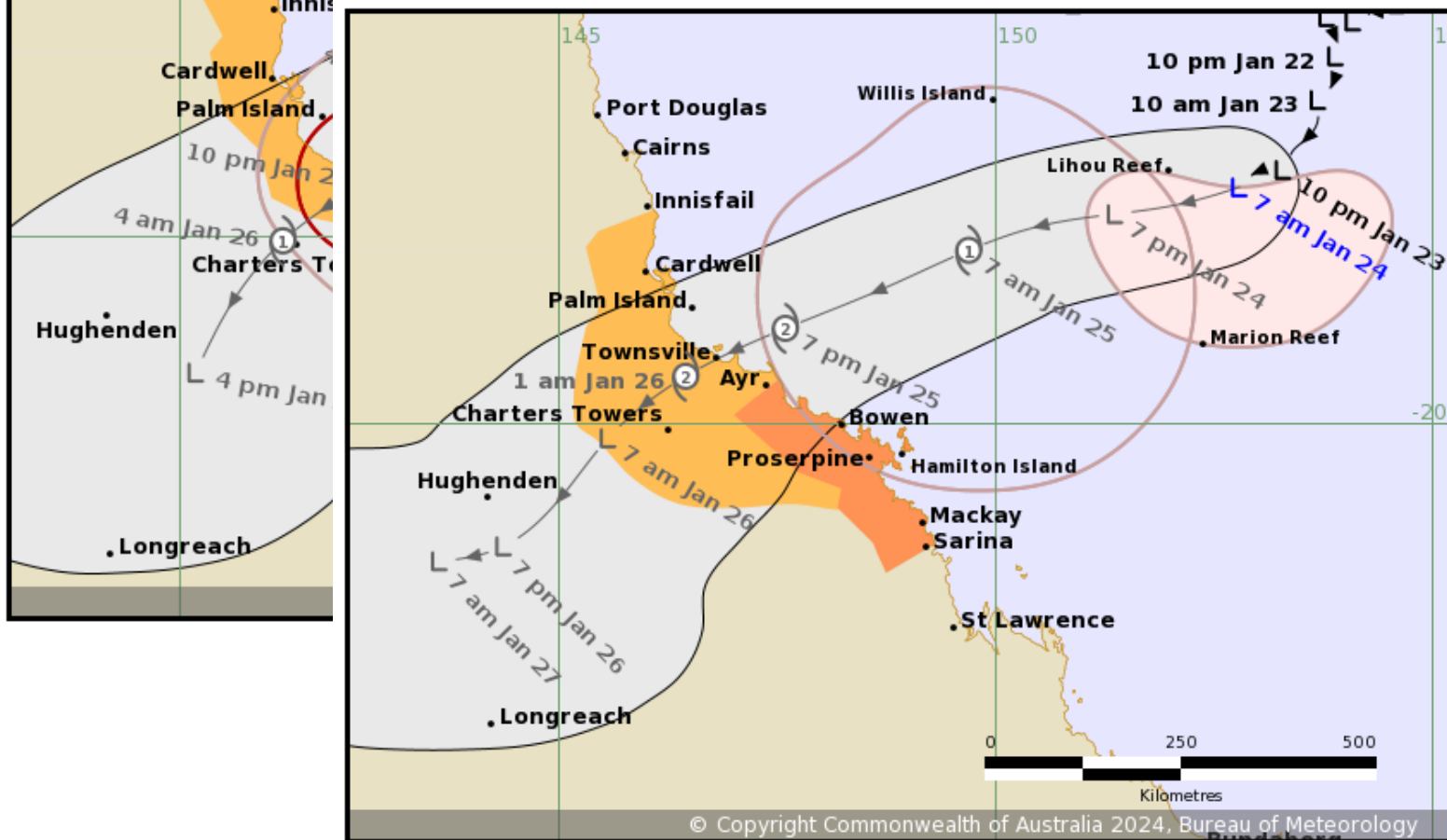


TC Kirrily
6 towers deployed in Townsville

Issued at 4:54 pm AEST Tuesday 23 January 2024. Refer to Tropical Cyclone Advice Number 7.



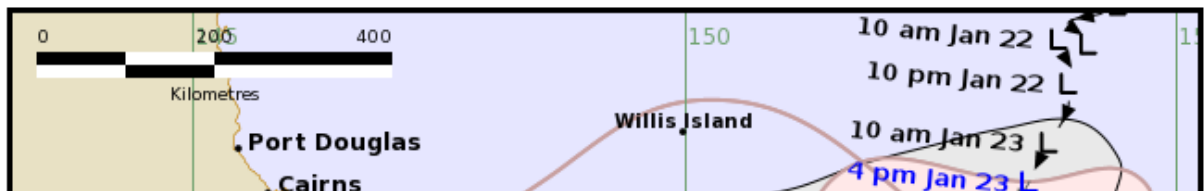
Issued at 8:04 am AEST Wednesday 24 January 2024. Refer to Tropical Cyclone Advice Number 12.



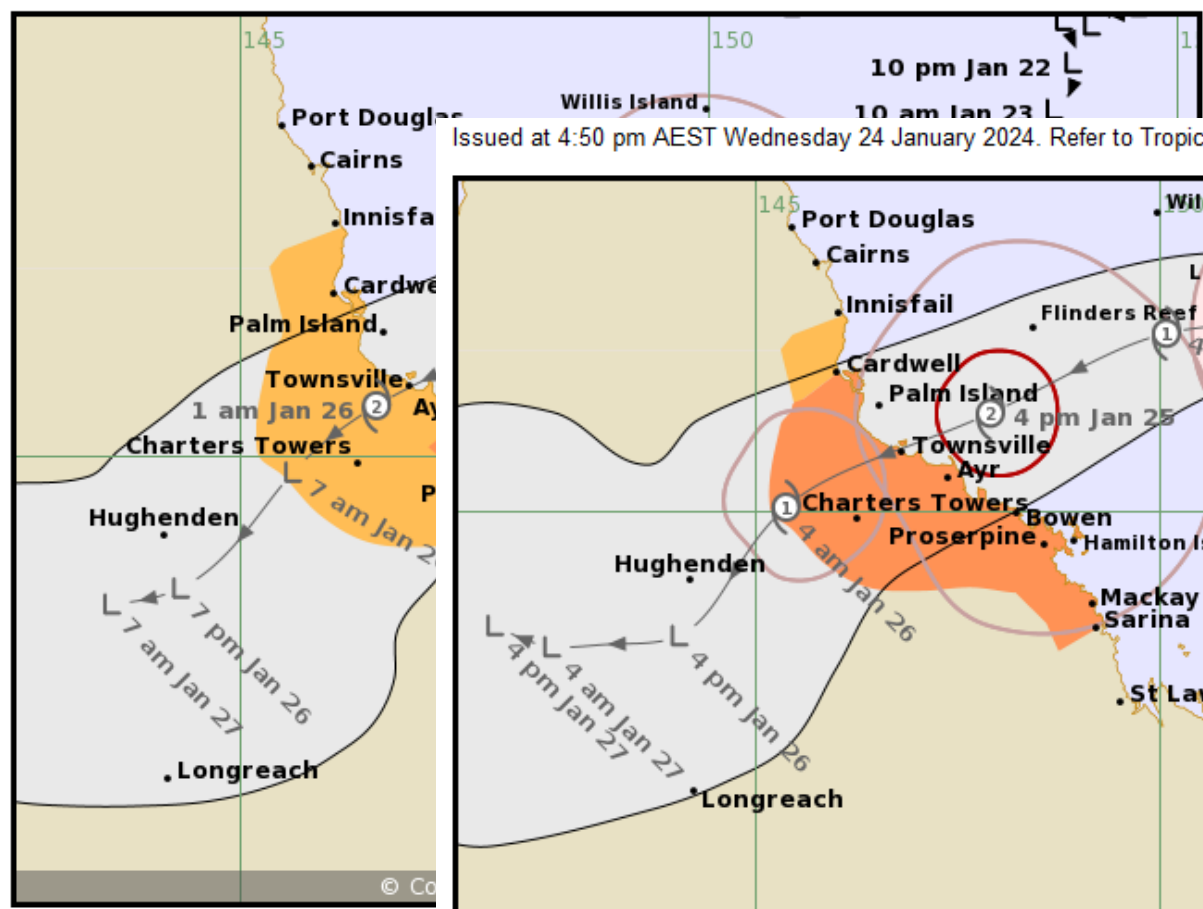
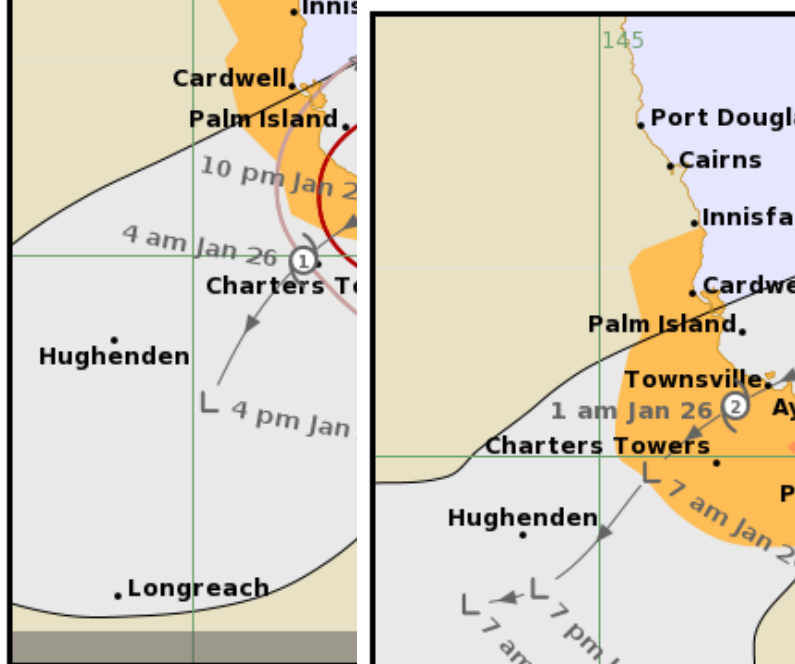
TC Kirrily
6 towers deployed in Townsville

Different focus for the deployment

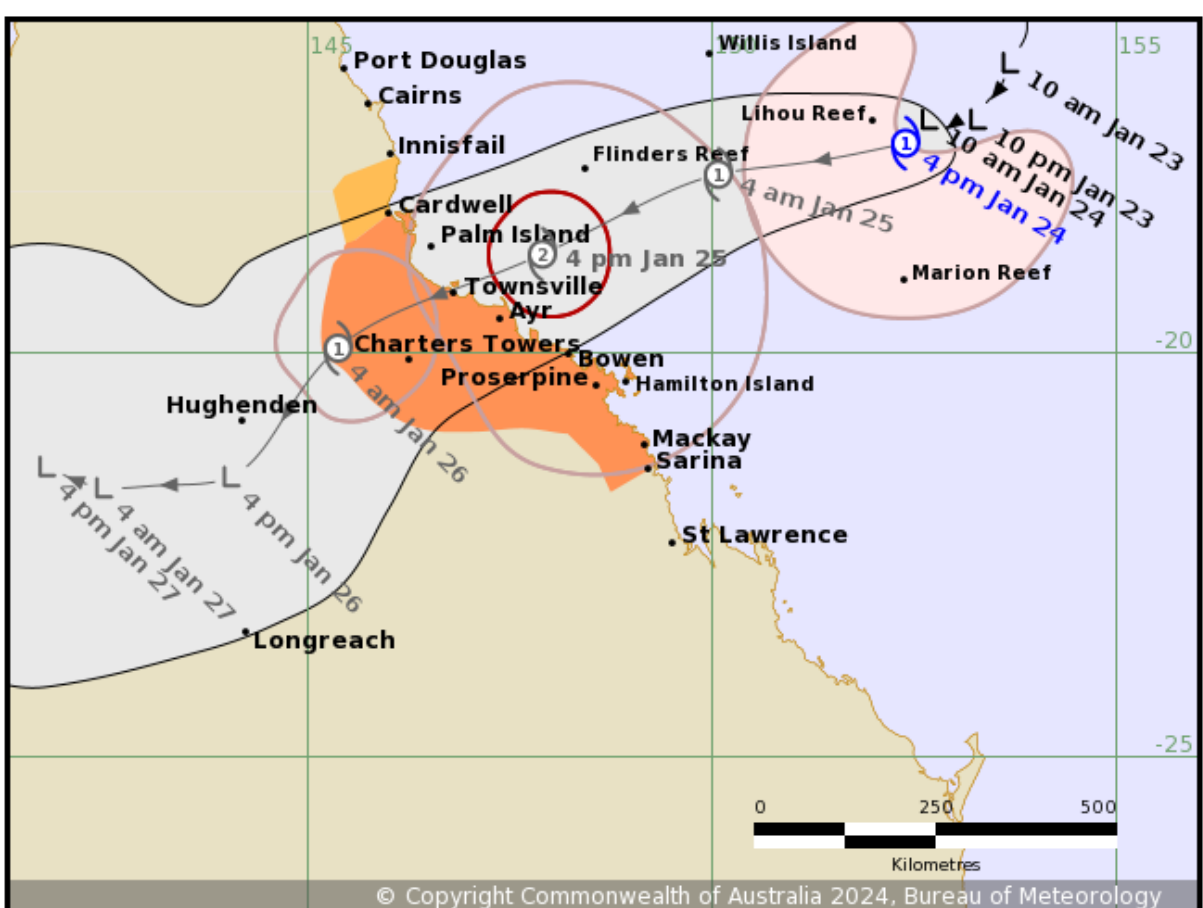
Issued at 4:54 pm AEST Tuesday 23 January 2024. Refer to Tropical Cyclone Advice Number 7.



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Issued at 4:50 pm AEST Wednesday 24 January 2024. Refer to Tropical Cyclone Advice Number 15.



TC Kirrily
6 towers deployed in Townsville

Different focus for the deployment

TC Kirrily

6 towers deployed in Townsville

Different focus for the deployment

Took the opportunity to evaluate wind speeds across a community for different terrains for different wind directions

Cleared land

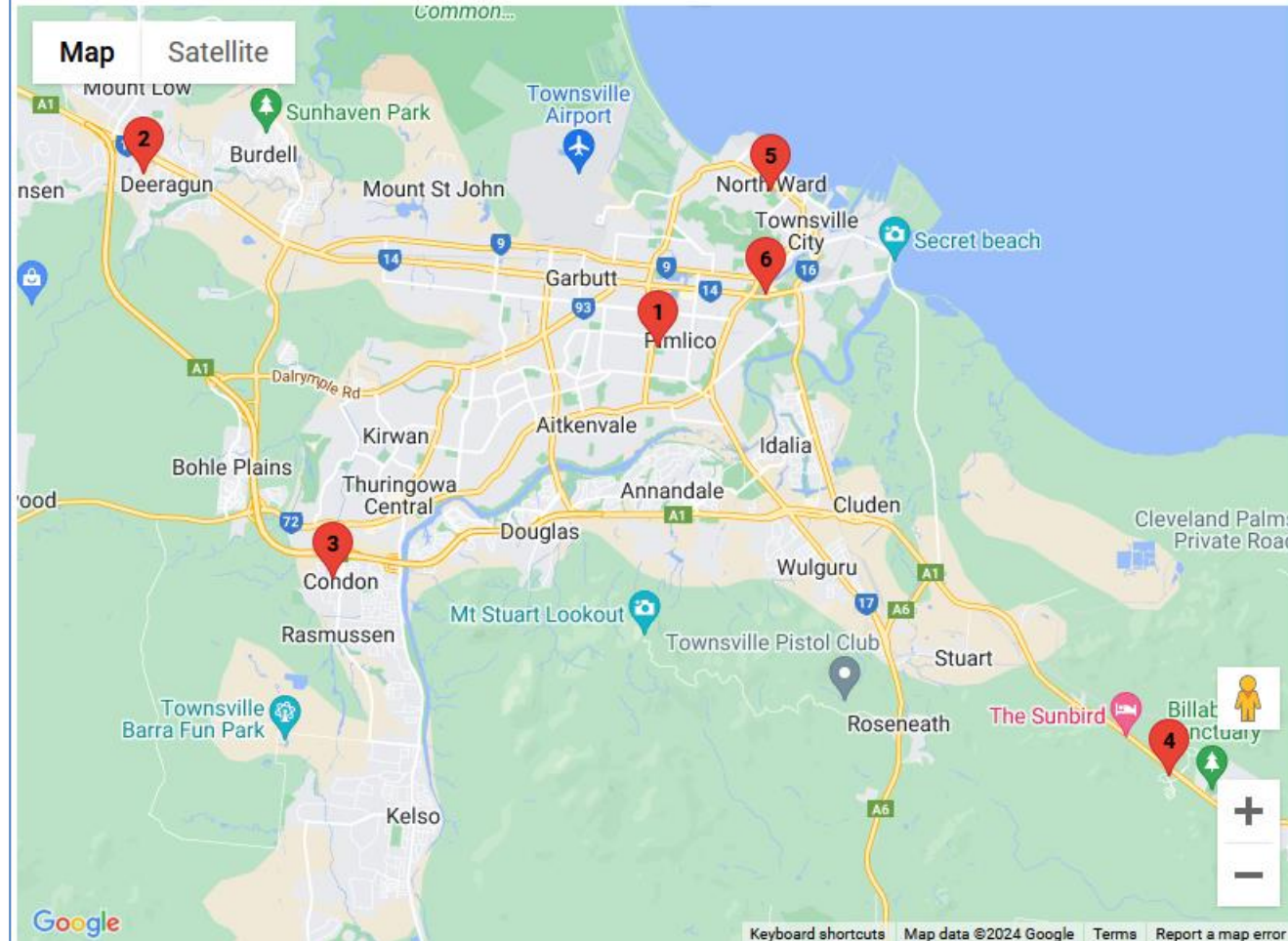
Sloping land

Adj to coast

N and S of castle hill (with BOM to W)

Middle of urban terrain

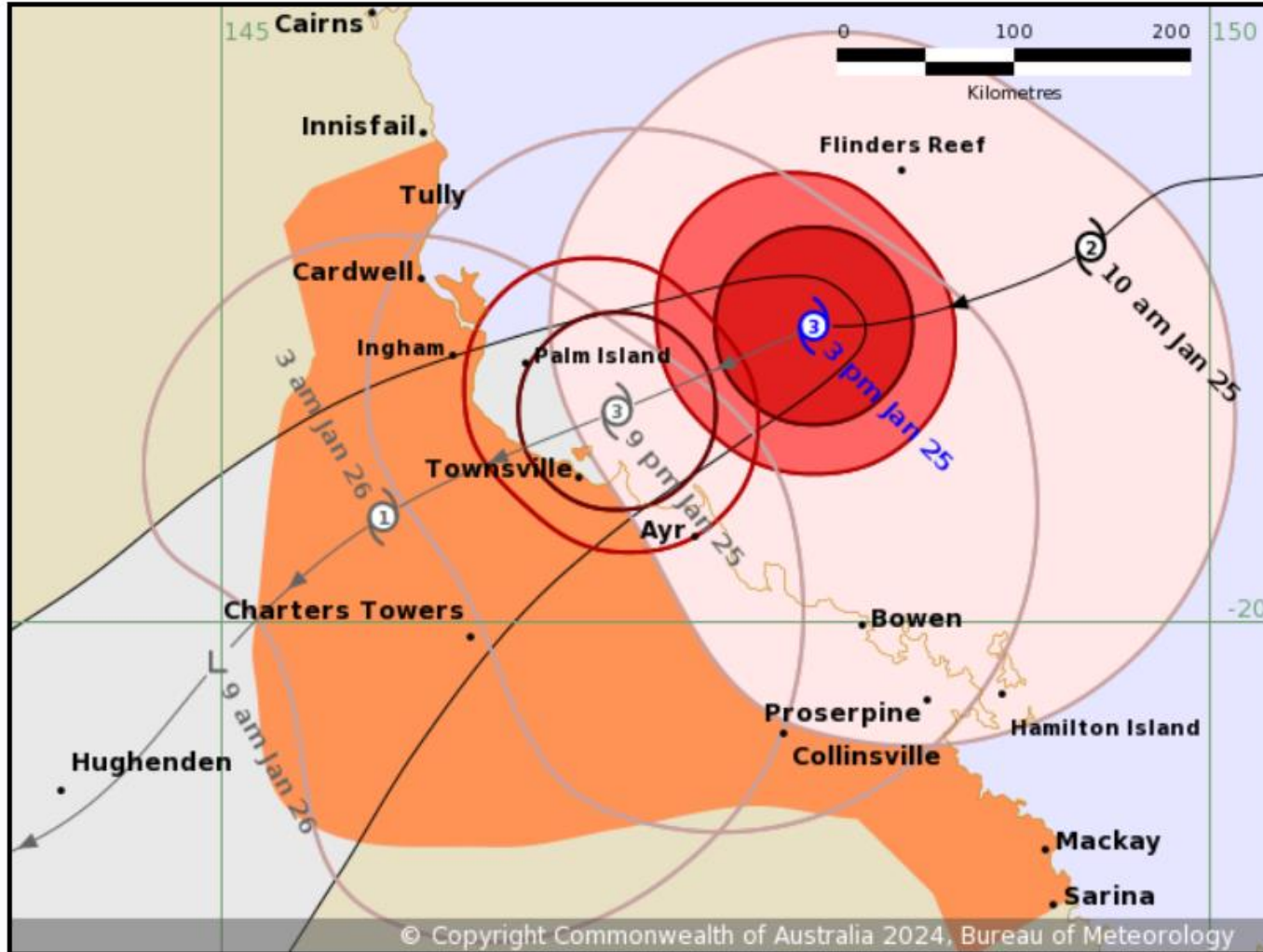
In semi-urban terrain



TC Kyrily

6 Issued at 2:58 pm AEST Thursday 25 January 2024. Refer to latest Tropical Cyclone Advice.

Different focus for the deployment



portunity to evaluate across a community terrains

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TC KIRRILY

6

Issued at 2:58 pm AEST Thursday 25 January 2024. Refer to latest Tropical Cyclone Advice.

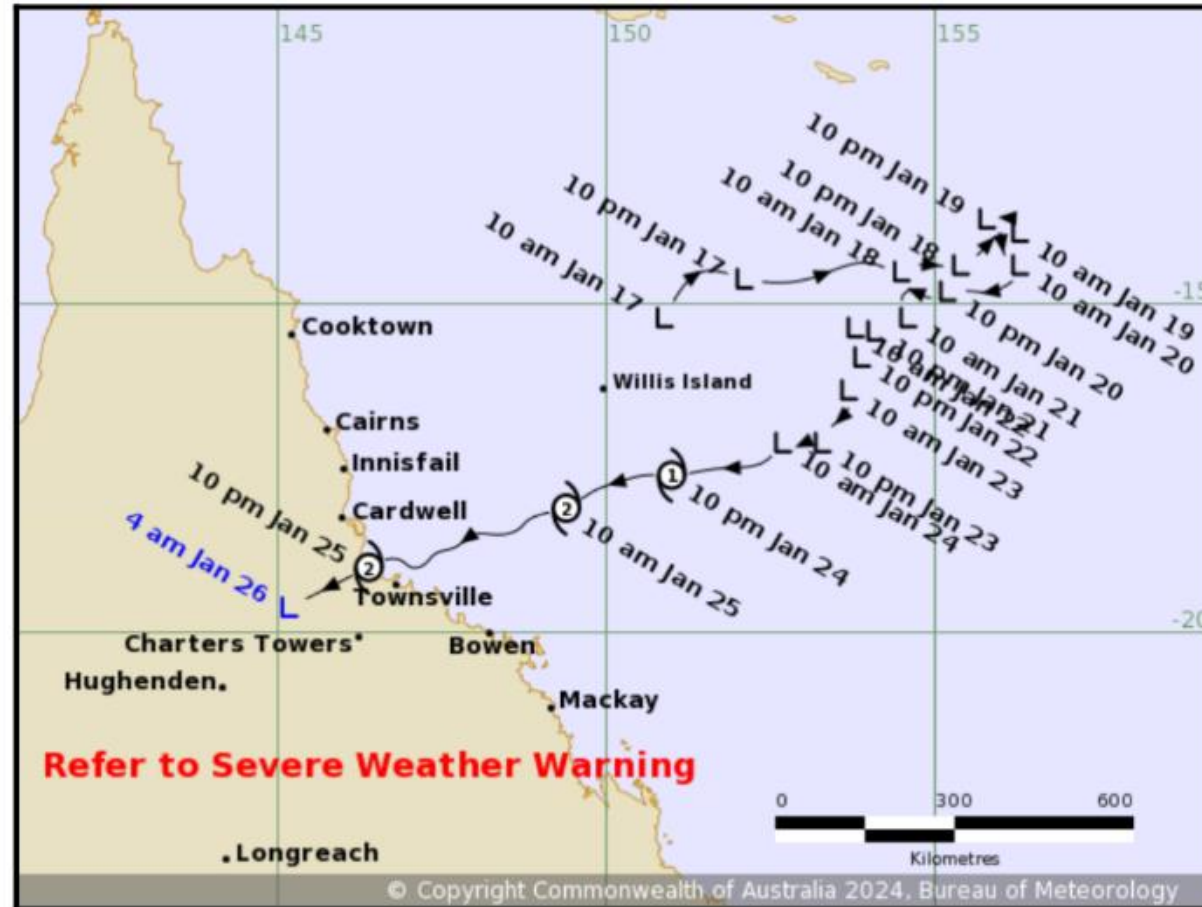
Different focus for the deployment



Ex-Tropical Cyclone KIRRILY

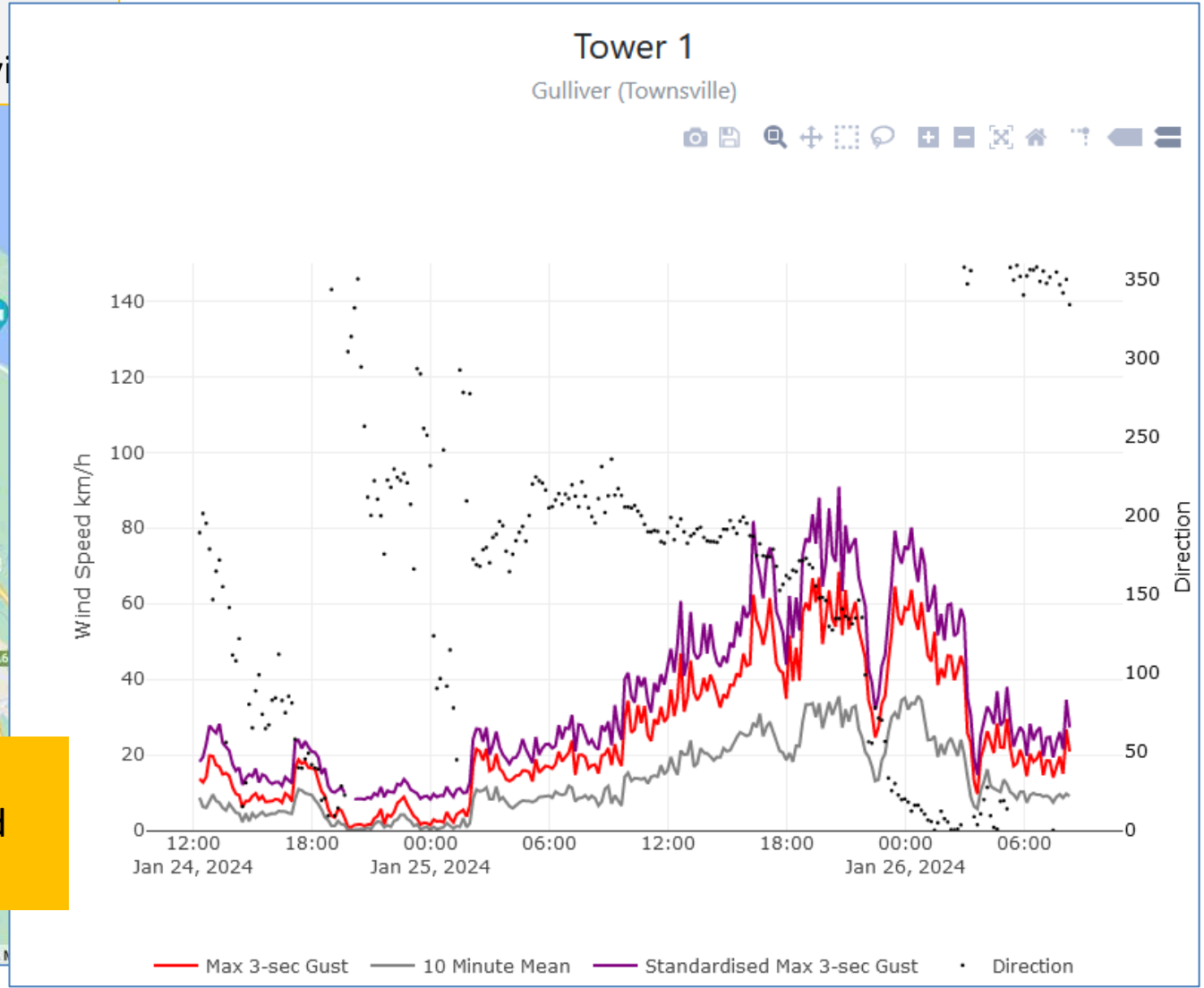
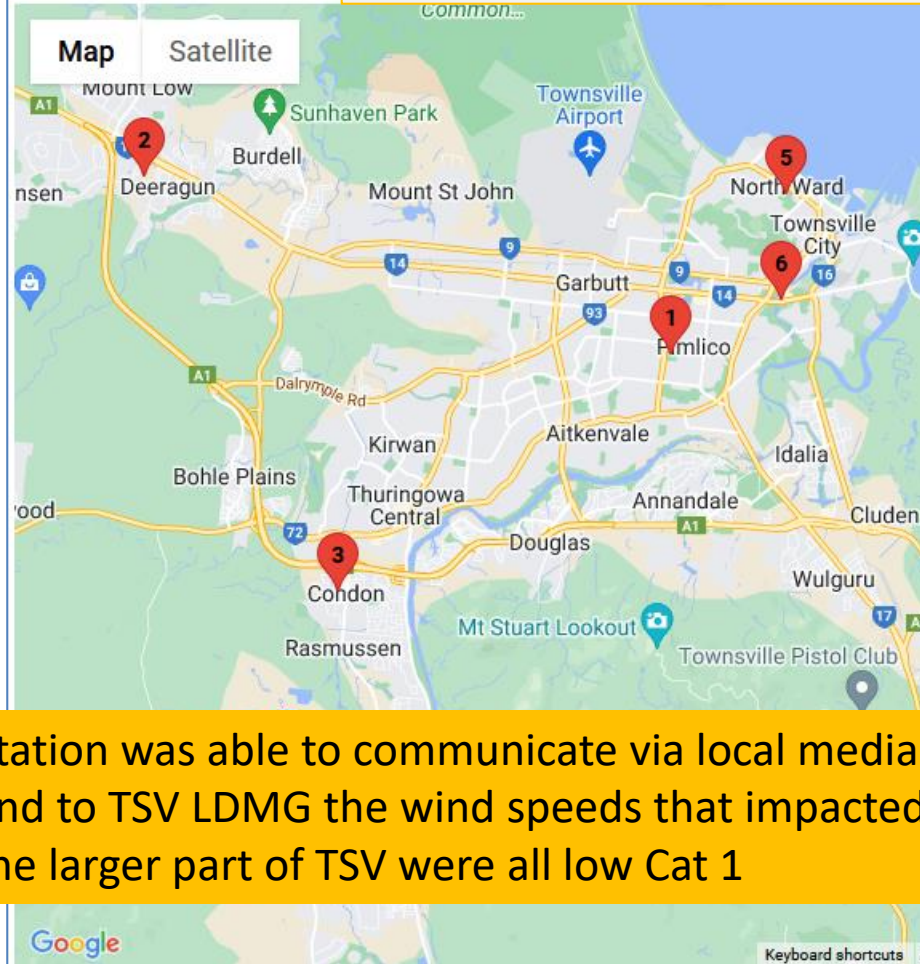
Issued at 5:04 am AEST Friday 26 January 2024. Refer to Tropical Cyclone Advice Number 37.

ability to evaluate
as a community
ins



TC Kirrily

6 towers deployed in Townsville



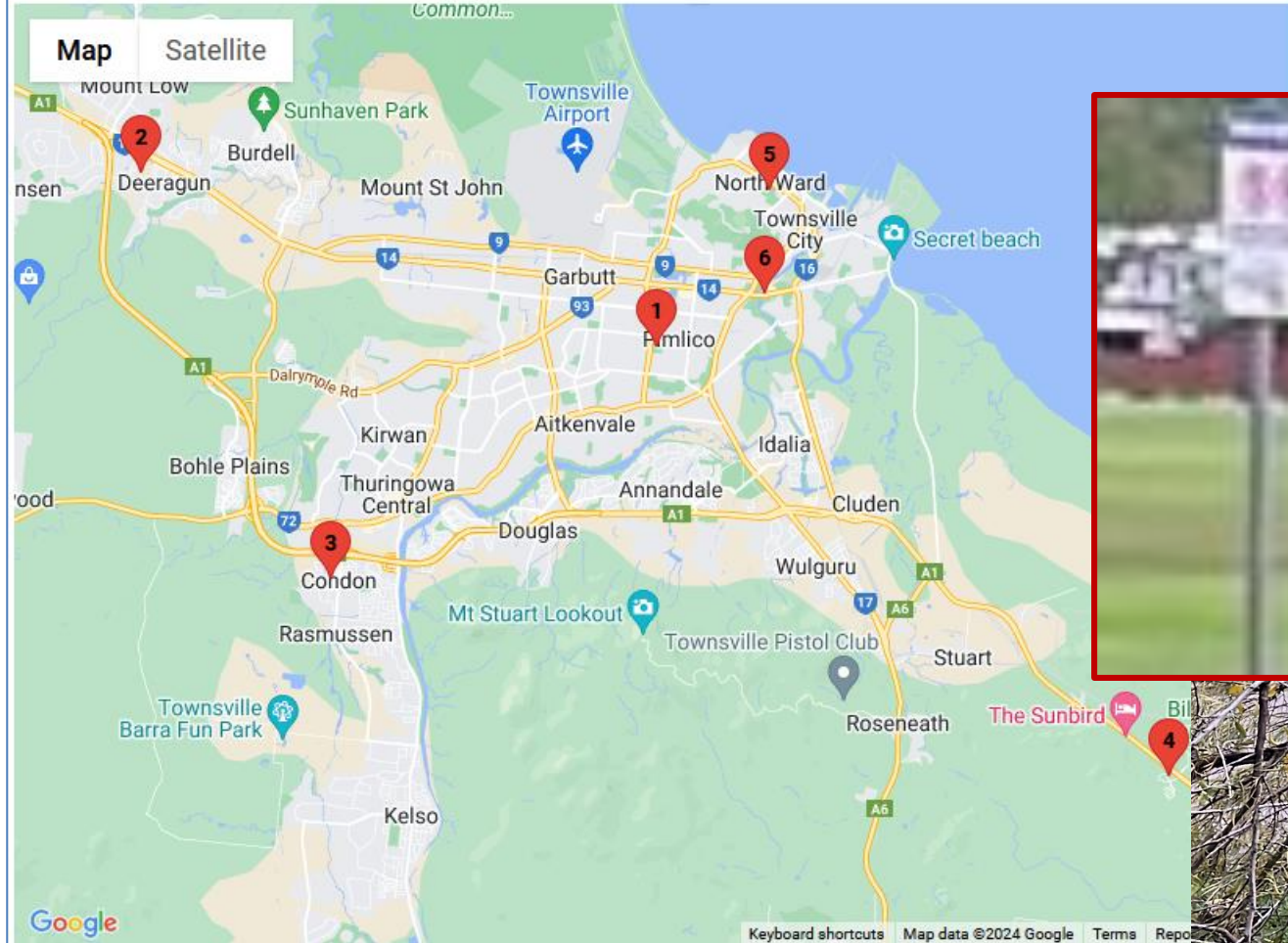
Station was able to communicate via local media and to TSV LDMG the wind speeds that impacted the larger part of TSV were all low Cat 1

Now for the interesting bits...

TC Kirrily

Towers

Different focus for the deployment



Take the opportunity to evaluate wind speeds across a community for

