Leveraging geospatial to assess the large-scale renewable generation potential of the Northern Territory

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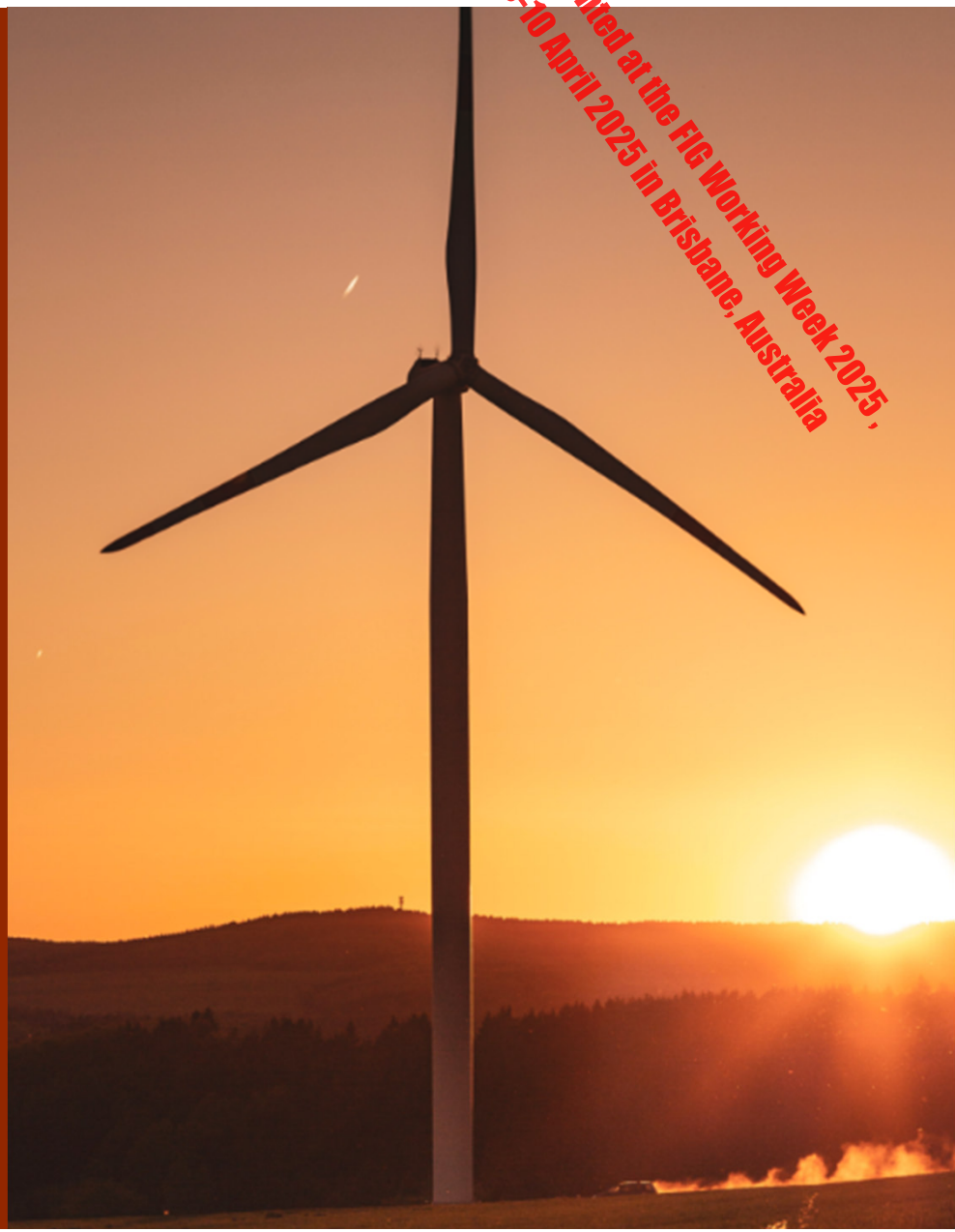
Jacobs

Challenging today.
Reinventing tomorrow.



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Acknowledgements

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Wind Resource Assessment and Wind Measurement Strategy for Large-Scale Wind Generation

NTG set strategic goals to focus on the growing clean, reliable and flexible energy sources.

These goals include

- Supporting the 50% renewable energy target by 2030
- Advancing a $40B economy by 2030
- The vision of net zero emissions economy by 2050

- Better understand Territory's wind resource potential to facilitate investment in large-scale wind generation projects
- Identify the most prospective areas for wind projects, with the intent to compile and publish pre-competitive wind data

Noting in comparison to other jurisdictions, the Territory doesn't yet have dedicated renewable energy zones

Expanding on deep domain knowledge with respect to the site selection for infrastructure development and thorough understanding of wind power

Application of SpatialLogic delivery framework

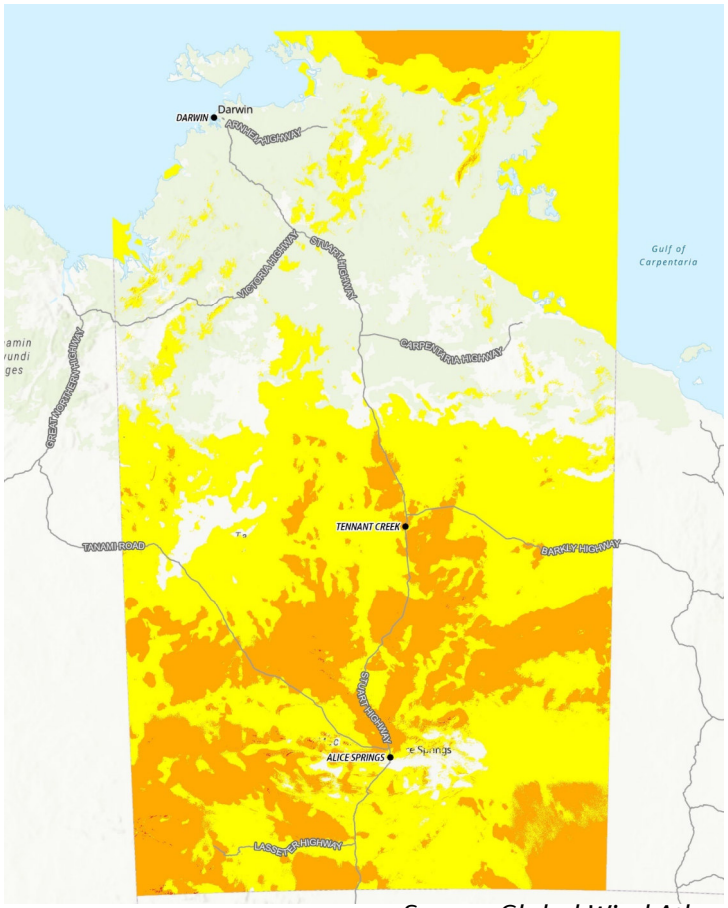
- Evidence based strategic approach to mapping the Territory's wind resources and identifying opportunities for wind generation.

- Rigorous and structured to creating information and undertaking analysis in a multivariate environment where conflicting factors needed to be balanced.

- Clearly defined relevant criteria that should be assessed and allow a robust identification of sites suitable for large-scale wind generation in the Territory.

used as the foundation for investing in more targeted and detailed assessments

NT Wind Resources



Source: Global Wind Atlas

Average wind speed @ 100 metres (hub height)

- 6-7 m/s
- 7-9 m/s
- >9 m/s.

Influencing Factors

- Sufficient wind present
- Is there an absence of factors that might be impacted by the turbines.
- Can the turbines be feasibly transported to and constructed at a given site

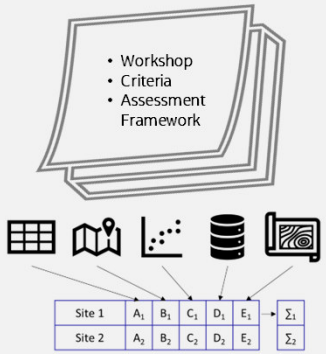
Considerations and Challenges

- Complexity of the study opposed to other jurisdictions
  - Vast remote area
  - Data Limitations
  - Low population density
  - Extensive Aboriginal owned land

Stakeholder Engagement

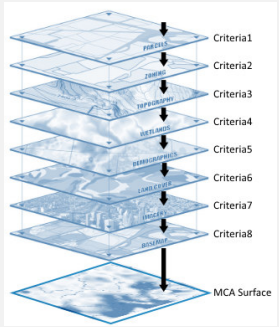
- NT Government cross-agency working group contributed to the early planning of the study to inform the study and catering for future wind project needs
- Range of stakeholders was consulted through the study, including:
  - Utility providers
  - Private developers
  - Organisations that manage climatic data such as BoM, GA, CSIRO

Site Selection Methodology



Definition

- Site Specifications
- Assessment Criteria
- Scoring matrix



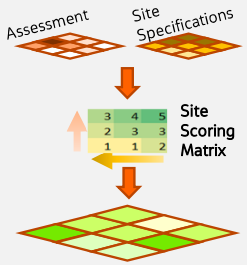
Assessment

•Data analysis
•Derive criteria layers
•Generate assessment area

Wind compatibility assessment

Economic assessment

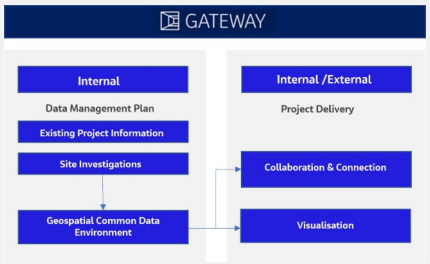
Land sensitivity assessment



Site Selection

Import
- wind compatibility
- land sensitivity

- Accumulate factors into total score
- Rank sites
- Prioritise sites



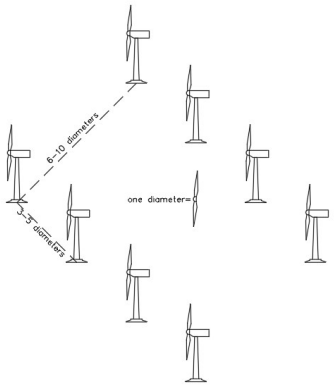
Outputs

Recommended preferred sites for investment in wind resources

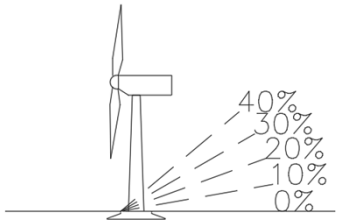
Site Specifications

Wind farm size critical to input to determine resolution of analysis

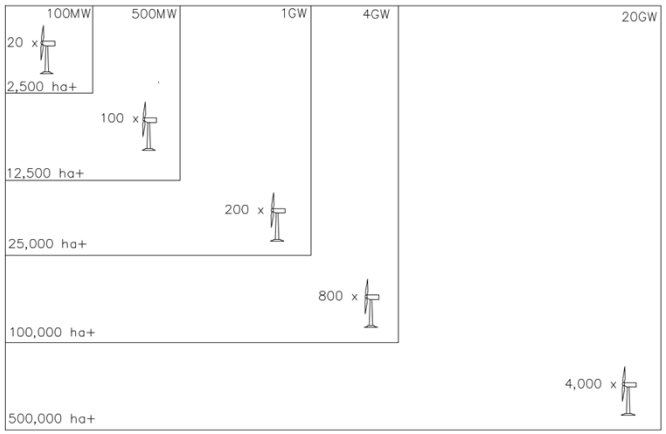
- Utility / Commercial Projects > 1MW
- Trend changing – increased capacity of single turbine
- 100 MW /20 Turbines /2,500 Ha - 1 GW /25,000 Ha / 20 Turbines)



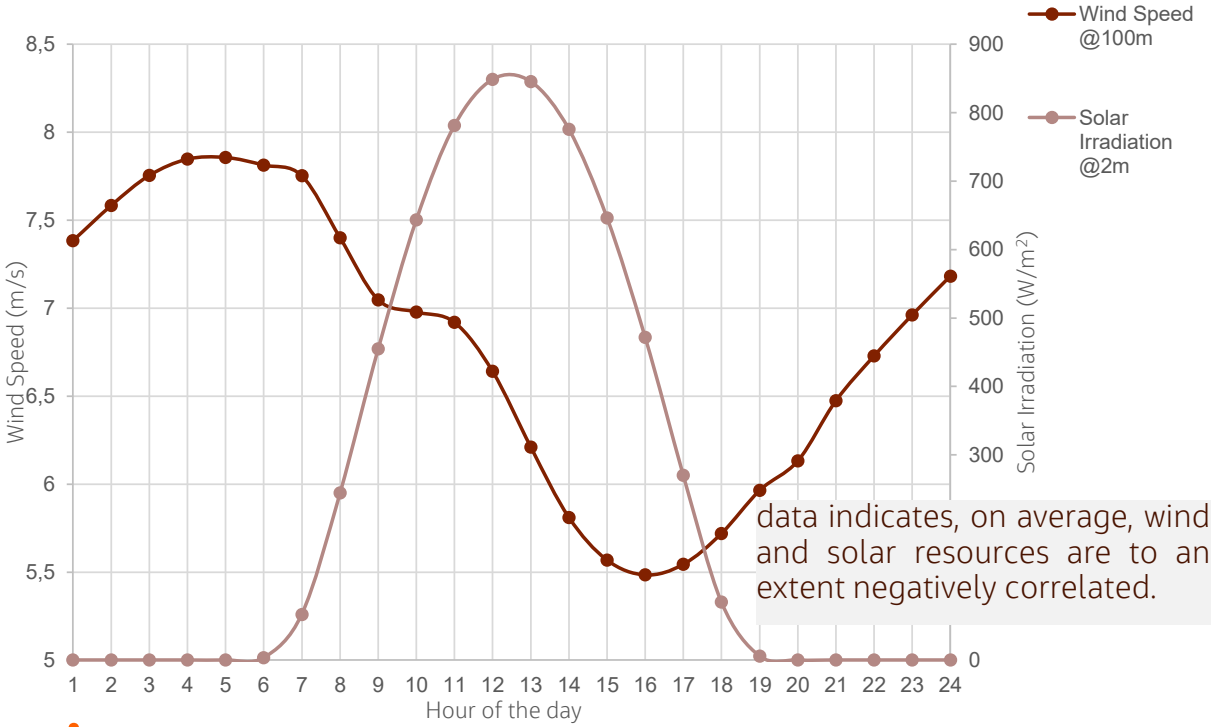
Wind Turbine Spacing (NTS)



Wind Turbine and Slope (NTS)



Indicative site sizes, installed capacity and number of turbines (NTS)



data indicates, on average, wind and solar resources are to an extent negatively correlated.

Wind and solar correlation

complementary profile between wind and solar, Barkly Region NT

Criteria Scoring

		Areas of highest compatibility based on wind farm infrastructure	Areas of highest sensitivity to wind farm infrastructure
Category	**Score**	**Scoring concept – Wind**	**Scoring concept – Land**
Least	1	Least Compatibility Areas of lower compatibility, areas exhibiting lower benefits to construction (e.g. 1,000km from existing infrastructure)	Least Sensitivity Areas of least sensitivity, areas exhibiting least complexity to construction (e.g., publicly owned)
Lesser	2	Lesser Compatibility Areas of lower compatibility, areas exhibiting lower benefits to construction	Lesser Sensitivity Areas of lower sensitivity, areas exhibiting lower complexities to construction
Medium	3	Moderate Compatibility Areas of moderate compatibility, areas exhibiting moderate benefits to construction (e.g. moderate wind speeds)	Moderate Sensitivity Areas of moderate sensitivity, areas exhibiting moderate complexity to construction (e.g. Commonwealth Land)
High	4	High Compatibility Areas of high compatibility, areas exhibiting very high benefits to construction (e.g. closer proximity to roads and ports)	High Sensitivity Areas of high sensitivity, areas exhibiting high complexity to construction (e.g. Conservation Areas)
Very High	5	Very High Compatibility Areas of very high compatibility, areas exhibiting very high benefits to construction (e.g. high wind speed categories)	Very High Sensitivity Areas of very high compatibility, areas exhibiting very high complexity to construction (e.g. World Heritage sites)

Assessment Exclusion Areas

criteria with the potential to impact on the overall viability of wind generation projects.

Criteria	Description	Rationale
Airports	Land used or occupied by an airport or proposed to be used as an airfield.	Airports and airfields are exclusion zones due to technical feasibility and height restrictions, a 5km buffer has been applied.
Communities	Census Urban-Centres and Localities / Remote Community Boundaries	Townships and Communities – land-use incompatible for major wind farm infrastructure and sites already occupied.
Water inundation	Waterways, waterbodies, and areas affected by flood or inundation	Waterways, water bodies, flood prone and water inundation areas due to the technical feasibility. These areas also have potential environmental or cultural factors, having differing levels of significance to conservation values.
World Heritage and Ramsar Wetlands	Any item or place identified in World Heritage Convention (UNESCO)	Due to their significance, World Heritage and Ramsar Wetland sites are excluded. Rigorous development constraints and limitations apply.
National & Territory Parks	Land occupied by a National or State Park	Due to their significance, national parks are excluded as development constraints and limitations apply.
Wind Speed	Areas with wind speeds of less than 6m/s	Areas with mean wind speed less than 6m/s are not considered to produce sufficient power to be considered economic.
Slope	Steep slopes	Areas with slopes are not feasible to construct wind turbines on. Areas of slope greater than 40% excluded.
Defence Site	Commonwealth Defence Reserves	Activity or development within defence land will be severely limited.
Temperature	Average temperature above 39 °C	Areas with average temperature above 39 °C. High temperatures can impact the performance with wind turbines ceasing to operate in temperatures above 40 °C. Higher operational range can be achieved using hot climate kits, but this is subject to turbine manufacturer specifications.
Atmosphere	Cyclonic Winds	Areas of very high cyclone intensity. When wind speeds are greater than the maximum operating limit of 25m/s, turbines are shut down and blades feathered to 90°.

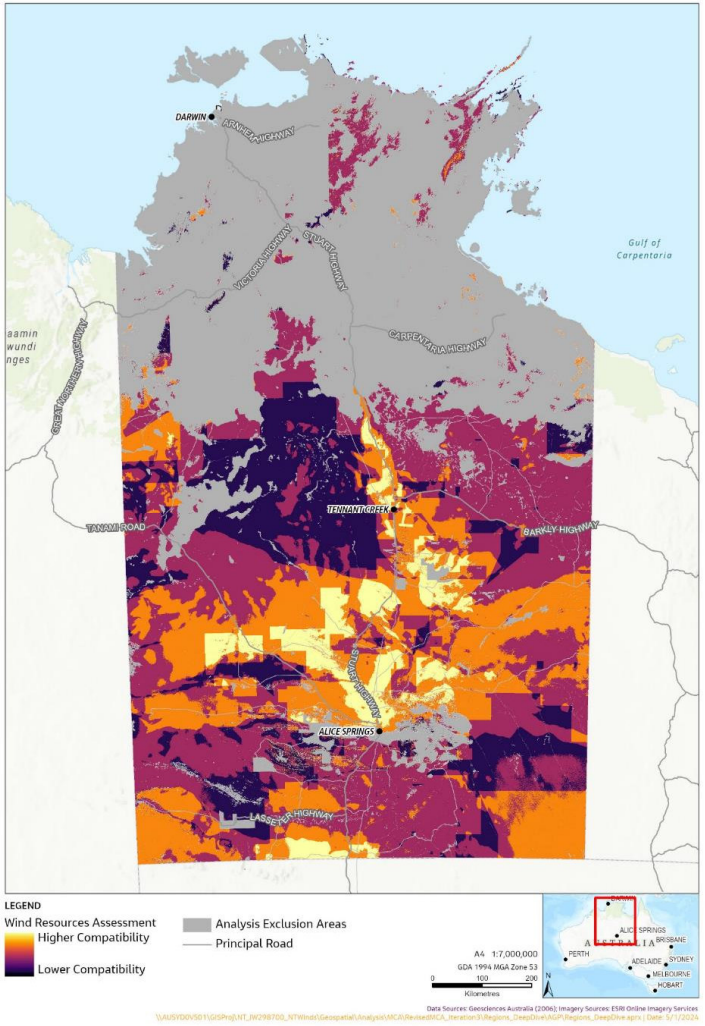
First Scenario - Wind Compatibility

evaluate the compatibility of the Territory to wind infrastructure

primary criteria for this scenario included wind speeds and topography

Assessment Theme	Criteria	Rationale	Score
Wind	Wind speed	Promote areas with higher wind speeds having greater energy potential.	• Moderate 6-7 m/s - 1 • High 7-9 m/s - 4 • Very high 9+ m/s -5
Topography	Slope	Wind turbines require construction on relatively flat terrain.	**Degrees:** • Low slope 20<25 -1 • Moderate 10<20 - 4 • Very high <20 - 5
	Geology	Certain geologies – granite, basalt, gabbro and others are particularly suitable for construction due to strength, suitability and load-bearing capacity.	3
	Soils	Some soil types do not have sufficient load bearing capacity and are not suitable for foundations.	NA
Land Use	Tenure	Land tenure may impact or inhibit development. Pastoral land – areas of existing agricultural land use, crown land, government owned/managed.	3
Environment	Bushfire	Bushfire management zones across the NT	NA
Climate	Solar irradiance	Areas with high solar irradiance potentially compatible with wind.	NA
	Lightning days	Lightning can impact on components of wind turbines. Less lightning days, less probability of component failures	NA **Compatibility:** • Moderate - <7 lightning days • Lesser – 14> = lightning days>7 • Least – lightning days >14

Potential to impact on the viability of wind development.



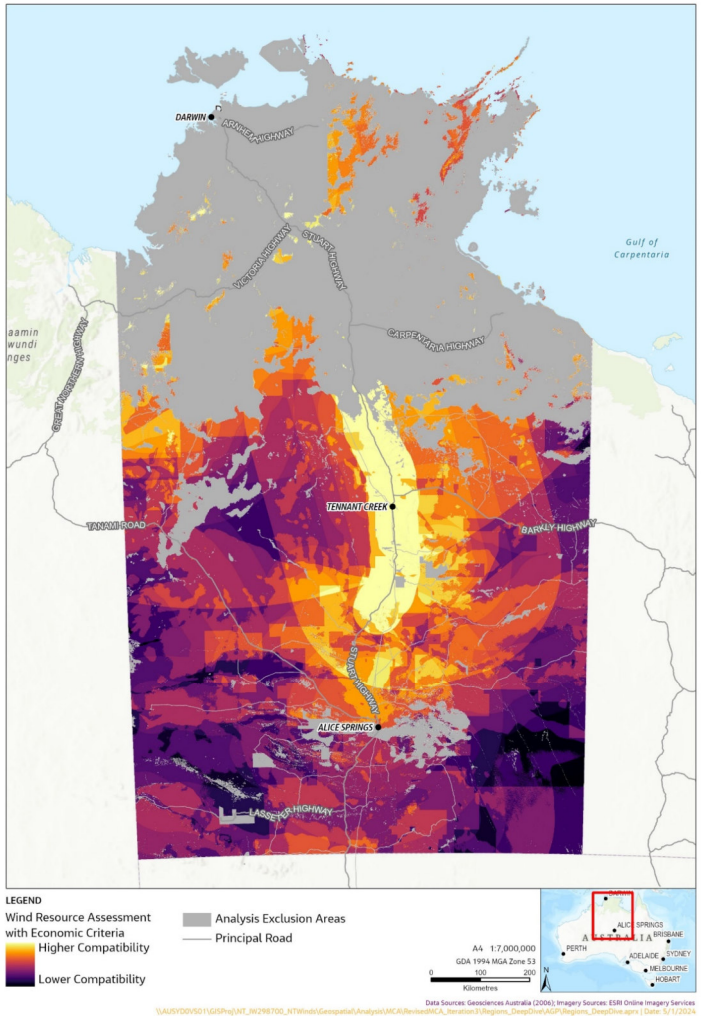
Second Scenario – Economic Drivers

Influential

primary criteria for this scenario included existing infrastructure and strategic areas

Criteria	Rationale	Score
Port Distance	Wind farm infrastructure requires transportation of large/heavy wind turbine components from international suppliers / manufacturers. Promote proximity to Ports, closer attracts a higher ranking. **Ranges applied:** • Moderate Compatibility: 750<1,000km • High Compatibility: 500<750km • Very High Compatibility: <500km	• 3 • 4 • 5
Logistics – Road/Rail	Wind farm infrastructure requires transportation of large/heavy wind turbine components from international suppliers / manufacturers. Proximity to Roads (major arterials)/Rail – closer attracts a higher ranking. **Ranges applied:** • Moderate Compatibility: 100<200km • High Compatibility: 50<100km • Very High Compatibility: <50km	• 3 • 4 • 5
Transmission Distance	Promote proximity to existing electrical transmission easements / corridors. Noting the absence of electrical transmission lines in all regions but the top end of the Territory.	NA
Strategic Importance	Areas of strategic importance for future development – gas/hydrogen/minerals Promote proximity areas of strategic importance, including existing major projects.	Scores range from 1-5
Strategic Infrastructure	Areas of strategic importance for future development – infrastructure/transmission. Including the proposed NT Infrastructure Corridor. Promote proximity areas of strategic importance, for power transmission and supporting infrastructure.	Scores range from 1-5
Resources / Mining Tenements and other industrial land uses	Land occupied by an operating mine or quarry; industry may benefit using renewable power source (decarbonisation). Opportunity to co-locate wind/solar and minimise operational costs of mine. Promote proximity to supply industry with power generation.	3

Economic factors considered as they will largely influence whether a developer proceeds with project development or not.

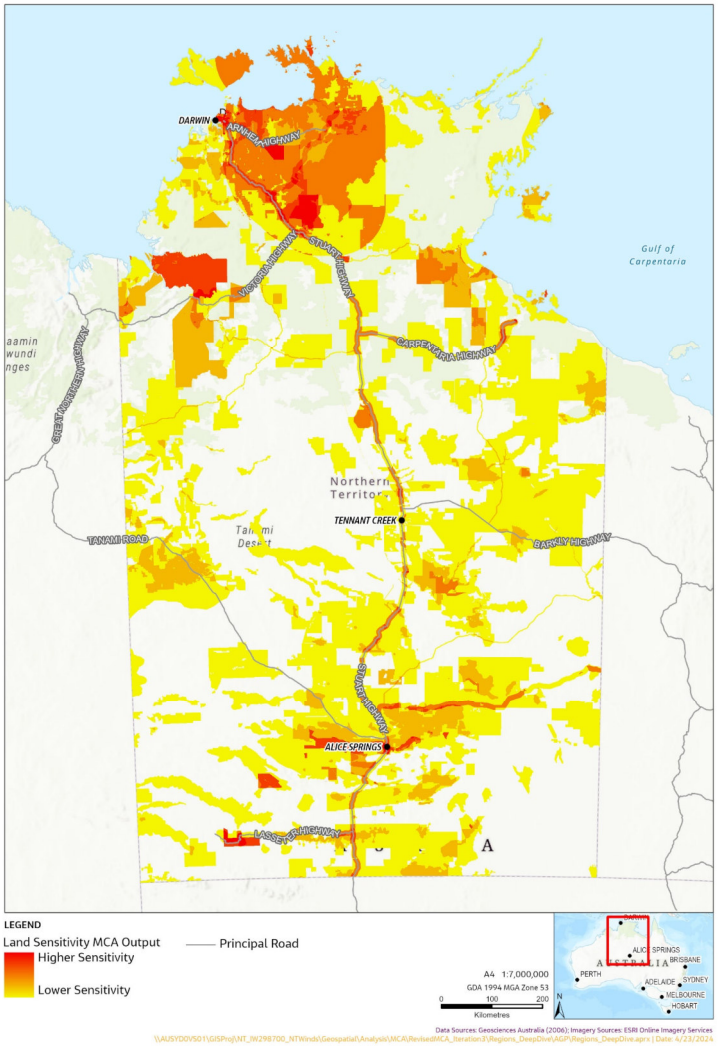


Third Scenario - Land sensitivity

Land sensitivity factors assessed,

noting need for some areas to be reconsidered in the presence of high wind compatibility or economic results.

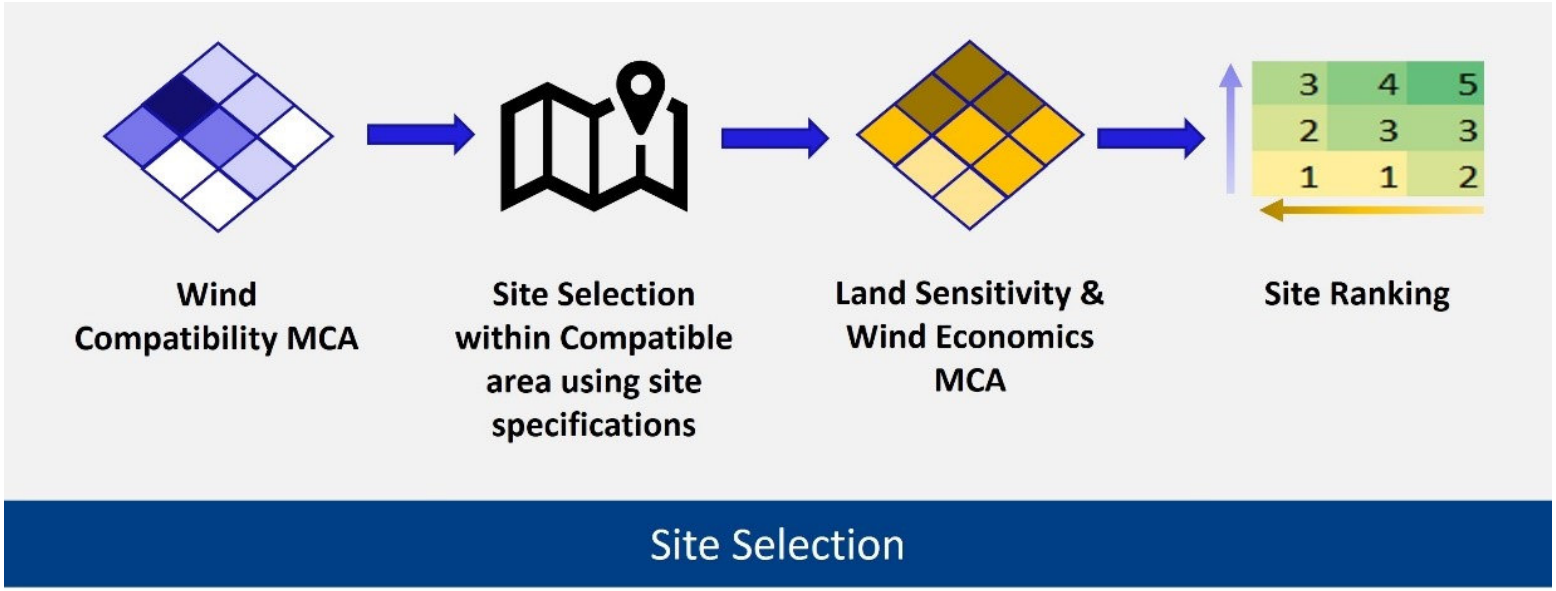
Assessment Theme	Criteria	Score
Environment	Conservation Areas/ Public Reserves and Parklands	5
	Native Vegetation	NA
	Significant Biodiversity Areas	3
	Nationally Important Wetland surrounds	4
	Groundwater	NA
Heritage	Historical Heritage – Commonwealth	5
	Historical Heritage – Territory	NA
	Indigenous Heritage – Territory	NA
	Indigenous Land Use Agreement (ILUA)	NA
Land Use & Planning	Resources and Mining Tenements	3
	Residential Areas/Township adjacent	3
	Contamination Areas	NA
	Commonwealth Land	3
	Tourist Roads	2-4



Site ranking

Sites ranked following assessment with parameters:

- Minimum size: 25 000 hectares
- Maximum size: no limit
- Evaluation method: Highest average value
- Shape: Square (trade off 50%)



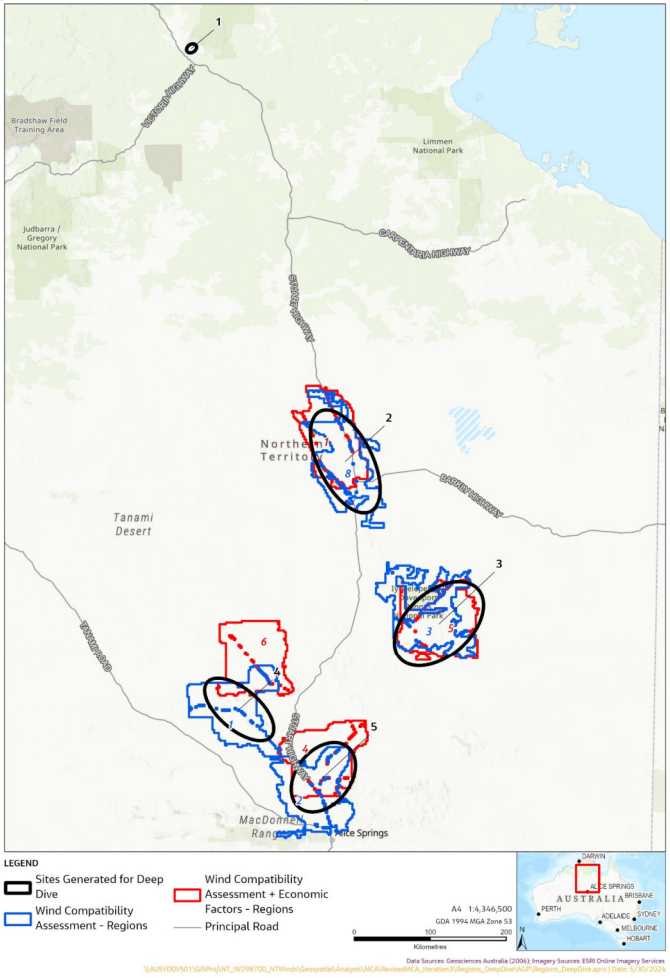
Deep Dive Sites

Five regions were selected for a deeper analysis, which provided a breakdown of the criteria present to provide a more in depth understanding of what was present at a site, and how the wind and economic drivers interplayed with land sensitivity.

- Selected based on a comparison of wind compatibility MCA and with wind compatibility combined with economic development MCA
- Consideration also given to where there is strategic benefit to understand the potential for wind resource development

Site Locations

- Site 1 – Northern Region (near Katherine)
- Site 2 – Near Tennant Creek
- Site 3 – Davenport Ranges
- Site 4 – Northwest of Alice Springs
- Site 5 – North of Alice Springs



Outcome

Given the strong wind resource potential

- NT Government now have web page regarding the Territory's Wind Potential
- Investment can be better encouraged by publishing industry standard wind resource information to assist prospective developers or investors
- The approach which can be built upon should proponents deem viable to invest in the development of wind projects and facilitate further studies

Wind Measurement Strategy

Whilst wind resource data is available, bankable data required for investment

- The Assessment informed the Wind Measurement Strategy
  - identifying areas to invest in obtaining industry standard wind resource data
  - intent to compile and publish pre-competitive wind data, to facilitate investment in large-scale wind generation projects.

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Important