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HIGH-LEVEL ENVIRONMENTAL CONSTRAINTS ANALYSIS TO IDENTIFY POTENTIAL RENEWABLE ENERGY SITES FOR PTX PRODUCTION AT THE PORTS OF SOUTH AFRICA

IMPRINT

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Executive Summary

This concise Environmental Screening Study (ESS) aims to identify potentially feasible sites for subsequent resource and economic analysis, based on key environmental and land use features that may prevent or constrain large-scale Renewable Energy (RE) for the production of green hydrogen (GH_2) and Power-to-X (PtX) derivatives.

The PtX regions that were considered are associated with commercial ports in South Africa that are well placed for export of PtX products to European and Asian markets, or have potential for local PtX off-takers:

1. Richards Bay
2. Coega
3. Mossel Bay
4. Saldanha Bay
5. Boegoebaai (proposed)

Spatial data representing key social-environmental features (terrestrial and aquatic ecosystems, conservation priorities and land use) were considered and subsequently classified as areas that should be avoided, areas that may be constrained, or areas that are mostly open.

Five less constrained or open sites were manually identified as potentially environmentally feasible locations for RE development in proximity of the considered PtX regions.

These sites provide the point of departure for further techno-economic wind and solar resource assessment and PtX production potential.

PtX region	Site	Latitude	Longitude
1. Richards Bay	1. Richards Bay	-28.8909	31.83867
	2. Koningskroon	-28.4644	31.35059
	3. Surreyvale	-28.1023	30.93949
	4. Kingsley	-27.9829	30.49421
	5. Waterbult	-27.8084	29.47587
2. Coega	1. North of Gqeberha	-33.5906	25.48333
	2. Kleinpoort	-33.3998	24.9339
	3. Aberdeen	-32.7274	24.1806
	4. Hofmeyr	-31.7535	25.78835
	5. East of Aberdeen	-32.4287	23.22422
3. Mossel Bay	1. Near Albertinia	-34.2568	21.62363
	2. Near Van Wyksdorp	-33.8195	21.53743
	3. Leeu Gamka / Prince Albert	-33.1110	21.76026
	4. Beaufort West / Aberdeen	-32.4251	23.21588
	5. Willowmore	-33.0097	23.29773
4. Saldanha Bay	1. East of Saldanha Bay	-32.9932	18.24893
	2. North of Cape Town, near Atlantis	-33.4990	18.36825
	3. Near Morreesburg	-33.2284	18.72773
	4. East of Clanwilliam	-31.9965	19.43567
	5. Between Worcester & Sutherland	-32.9901	19.78011
5. Boegoebaai	1. East of Boegoebaai	-28.6989	16.74826
	2. Between Port Nolloth & Boegoebaai	-29.0270	16.92691
	3. West of Springbok	-29.5267	17.22556
	4. North-east of Springbok	-29.3648	18.44129
	5. North-west of Garies	-30.3968	17.70413

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Table of Contents

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List of Figures

List of Tables

List of Abbreviations

CBA	Critical Biodiversity Area
EGI	Electricity Grid Infrastructure
EIA	Environmental Impact Assessment
ESS	Environmental Screening Study
GH_2	Green hydrogen
PTX	Power-to-X
RE	Renewable energy
REDZ	Renewable Energy Development Zone
REEA	Renewable Energy EIA Applications
WEF	Wind energy facility

1. Background and Overview

GIS analysis has increasingly become a crucial tool for sustainable infrastructure planning. It is used around the world for identifying suitable and optimal areas, based on a range of environmental, economic, and social parameters, for important infrastructure developments (Department of Environmental Affairs (DEA), 2015; Latinopoulos & Kechagia, 2015; Sánchez-Lozano et al., 2014), including more recently, for renewable energy (RE) and green hydrogen (GH_2) production (Messaoudi et al., 2024).

Diligent site selection of RE is crucial to minimise the risk of (World Bank Group, 2024):

- impacts on communities and biodiversity;
- difficulties in obtaining financing and permits;
- time and cost increases; and
- public opposition to development.

Geospatial suitability is best determined in a stepwise manner, starting at broad scales to highlight several potential regions which may be investigated further, before conducting more detailed site screening, considering alternatives, ground-truthing and in situ assessment to inform development decisions.

This concise Environmental Screening Study (ESS) aims to identify potentially feasible sites for subsequent resource and economic analysis (refer to separate report "Renewables Resource Assessment and Financial Modelling for Wind and Solar Projects at the South African Ports"), based on key environmental and land use features that may prevent or constrain large-scale RE for the production of GH_2 and Power-to-X (PtX) derivatives.

2. Objectives

The PtX Hub aims to supply South African-specific green hydrogen analysis data to inform GH_2-related public sector policy development and private sector investment decisions. To determine RE, and subsequently GH_2 and PtX, potential of possible South African PtX regions in a manner that considers social-environmental sensitivities, a high-level social-environmental constraints spatial analysis was performed.

3. Methodology

The PtX regions that were considered are associated with commercial ports in South Africa that are well placed for export of PtX products to European and Asian markets, or have potential for local PtX off-takers:

1. Richards Bay
2. Coega
3. Mossel Bay
4. Saldanha Bay
5. Boegoebaai (proposed)

The study area for each of the PtX regions is a 300 km radius from the port location.

The social-environmental constraints analysis entailed an overlay of available spatial data (Appendix) for:

- **Conservation planning** –
    - Protected Areas that are protected under law. Must be avoided by energy development.
    - Critical Biodiversity Areas (CBAs) have been identified through systematic conservation planning processes and are important for the persistence of ecosystems and species as well as the long-term ecological

functioning of the landscape as a whole (South African National Biodiversity Institute (SANBI), 2017) (South African National Biodiversity Institute (SANBI), 2017.)

- **Aquatic ecosystems** –
    - Watercourses, including wetlands and rivers (ephemeral and perennial), should be avoided by new energy development. Proximity to watercourses may also trigger the need for non-consumptive water use licenses, which adds a permitting requirement to new development.

- **Land use** –
    - Urban and built-up areas which are already occupied by infrastructure and / are populated.
    - Agriculture – permanent / perennial agriculture like vineyards and orchards should be avoided. Annual crops, like grains, may present more opportunities for negotiating land use change or synergistic multi-functional spaces.
    - Mines and quarries are likely in conflict with energy developments but may provide an opportunity for synergistic multi-functional spaces or for targeting disturbed areas for brownfield development.

Social-environmental features considered (Table 1) classified as follows:

- **Avoid**: Areas that may be considered as unavailable, potential fatal flaws or critical conflicts for utility-scale renewable energy development.
- **Constrained**: Areas that may be considered as constrained for utility-scale renewable energy development. In the case of rivers and wetlands, new development within 32 meters would require non-consumptive water use authorisation (i.e. procedural constraint). In the case of landcover / uses, these areas may be potential opportunities for new utility-scale renewable energy development sites but would require a transition to new / multi-purpose land use or innovative co-location approaches such as agrivoltaics.
- **Mostly Open**: Areas that may be considered as potential areas for new development in terms of land availability (least constrained / open / undeveloped land).

Table 1: Social-environmental features and associated constraints ratings and consideration rationale

Class	Feature	Rationale
AVOID	Protected Areas, Nature Reserves, Conservation Areas	Areas protected under law. Must be avoided by energy and other industrial development.
	Critical Biodiversity Areas (CBA 1 & 2, all subcategories)	Areas are identified through systematic conservation planning processes and are important for the persistence of ecosystems and species as well as the long-term ecological functioning of the landscape.
	Rivers and wetlands	Aquatic ecosystems should be avoided by new energy and industrial development.
	High-value agriculture, including Viticulture, Horticulture, Pivot Irrigation, Non-pivot Irrigated Annual Crops / Planted Pastures, Food Gardens	High-value permanent / perennial agriculture, like orchards, or that are characterised by large permanent infrastructure, such as irrigation systems, should be avoided.
	Built-up landcover	Areas that are already occupied by infrastructure and / or where people live and work.
CONSTRAINED	Rivers and wetlands 32 m buffer	Proximity to watercourses may also trigger the need for non-consumptive water use licenses, which adds a permitting requirement to new development.
	Rainfed Annual Crops / Planted Pastures, Smallholdings, Strip Field Cultivation, Old Fields, Shadenets	Annual crops, like grains, may present more opportunities for negotiating land use change or synergistic multi-functional spaces (e.g. shadenet agriculture as agrivoltaics).
	Mines & quarries landcover	Likely in conflict with energy developments but may provide an opportunity for synergistic multi-functional spaces or for targeting disturbed areas for brownfield development.
OPEN	Remaining areas, including Barren Land, Forested Land, Shrubland, Grassland landcover	Areas that, based on the spatial data considered, could theoretically present opportunities as development sites.

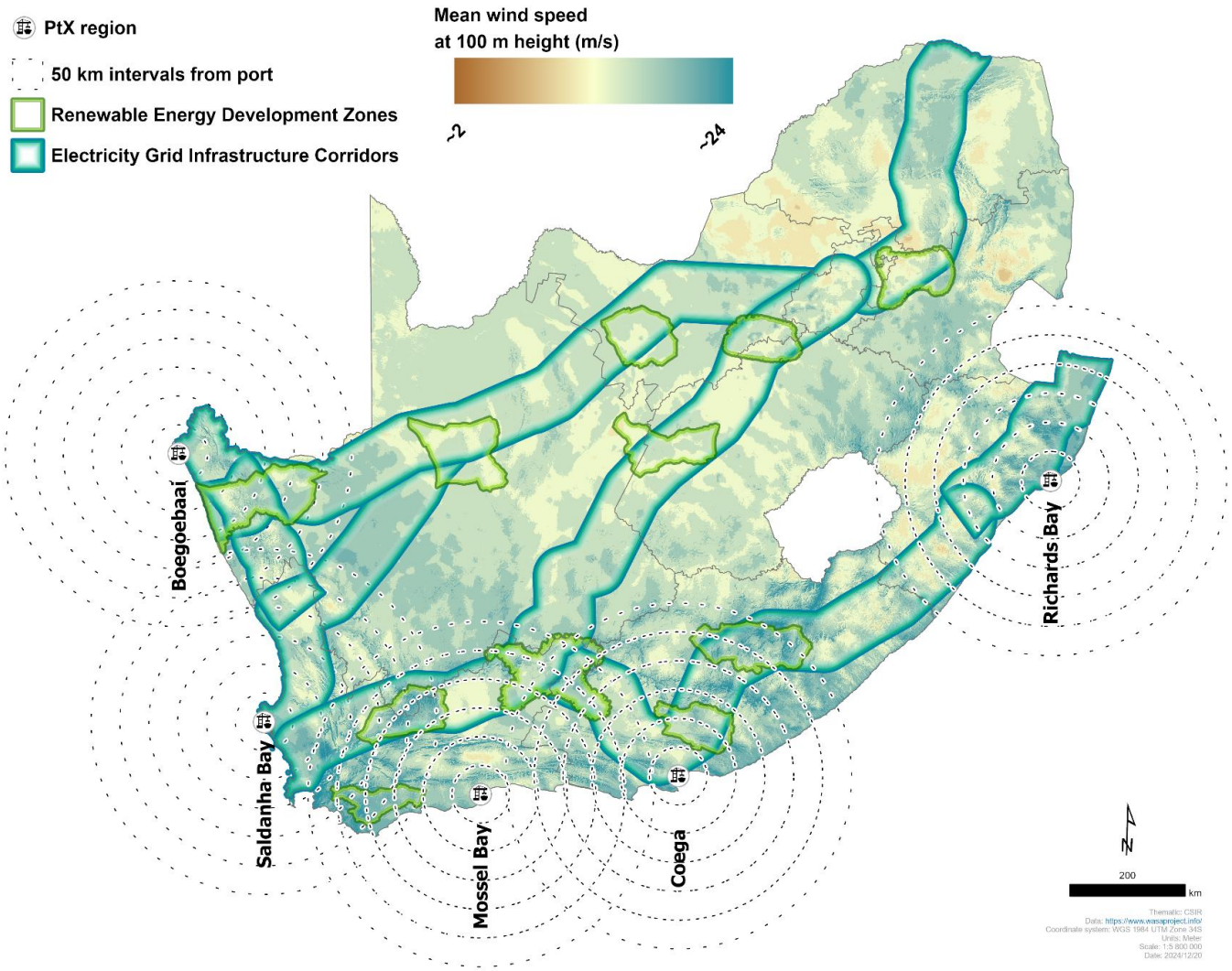
The spatial overlay analysis followed the maximum rule – i.e. if restricted and constrained features overlap, the restricted feature will take precedence. Any areas that do not contain any of the restricted on constrained features are considered potentially 'open' or least constrained for energy development.

4. Results and Discussion

4.1 Wind and Solar Energy Potential

South Africa has good renewable energy resource potential, with wind (Figure 1) being more prominent along the coastal regions and solar (Figure 2). in the inland regions. Furthermore, policy instruments, such as Renewable Energy Development Zones (REDZs) and Electricity Grid Infrastructure (EGI) corridors, are in place to incentivise renewable energy development. This indicates opportunity for RE development proximal to the considered PtX port location, but such RE development may need to extend within broader regions to satisfy the energy requirements of PtX production.

Figure 1: Mean wind speed at 100 m height (m/s) for South Africa.



Source: own creation, data from Wind Atlas for South Africa (WASA) SANEDI.

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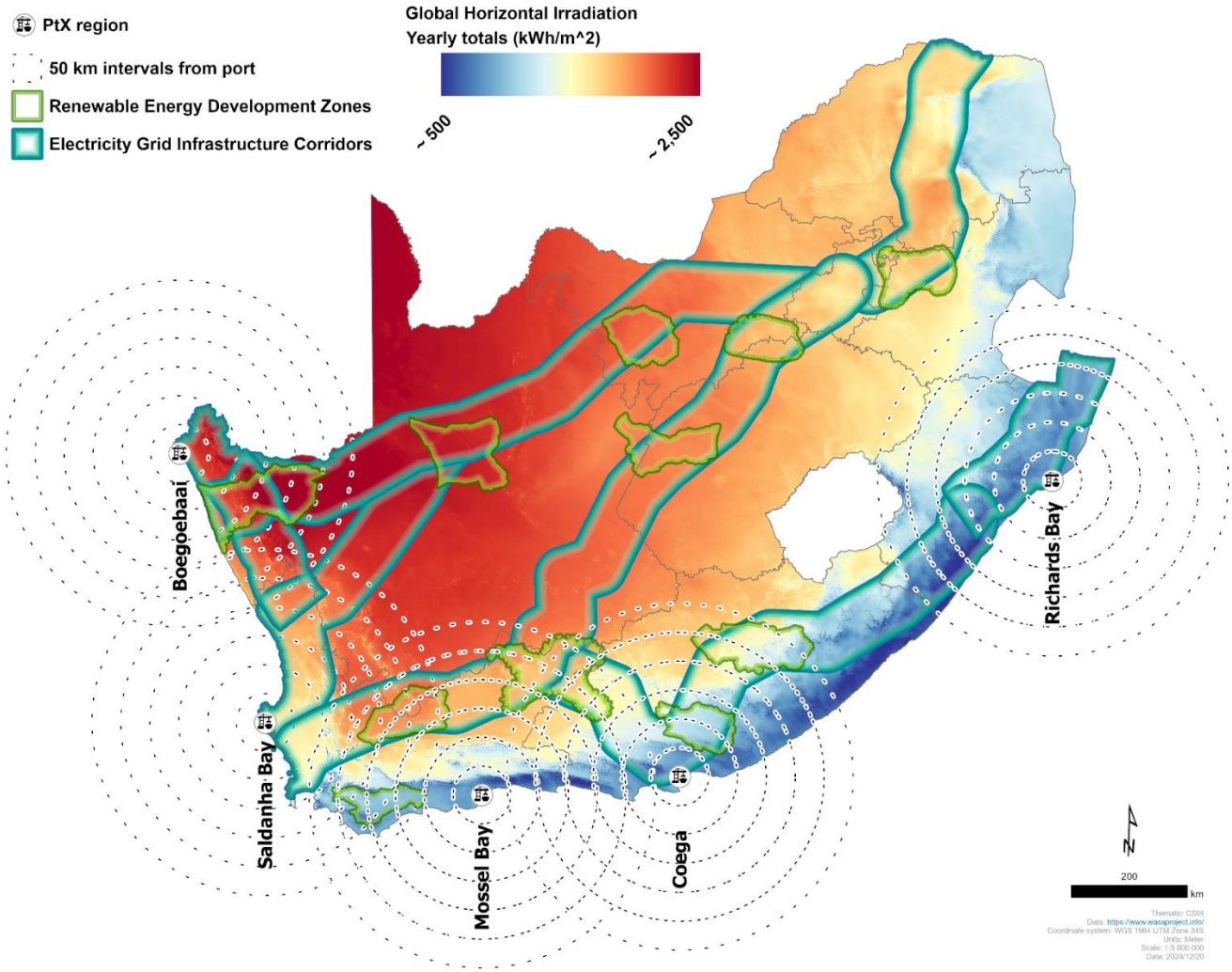
Figure 2: Solar renewable energy resource (Global Horizontal Irradiation, yearly totals, kWh/m2) of South Africa



Source: own creation, data from SolarGIS solar resource maps and GIS data

4.2 Richards Bay

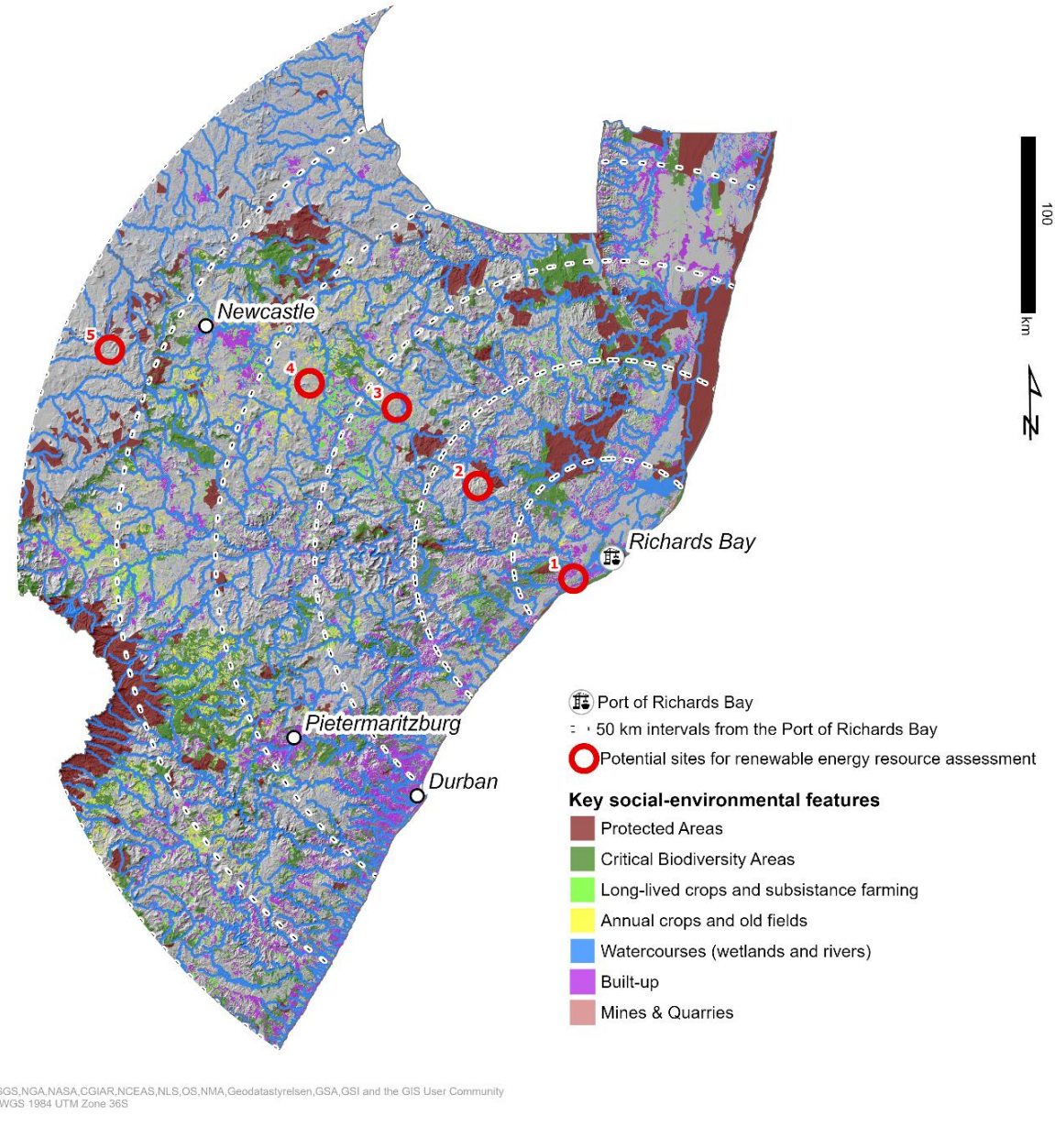
The Port of Richards Bay is located approximately 150 km north of Durban in KwaZulu-Natal. The region is a matrix of watercourses, agricultural activities and built-up areas (Figure 3).

Based on the high-level environmental screening, the following sites in the Richards Bay region may be considered as potentially 'open' for RE and green hydrogen developments (Table 2).

Table 2: Potential sites for subsequent renewable energy resource assessment at Richards Bay

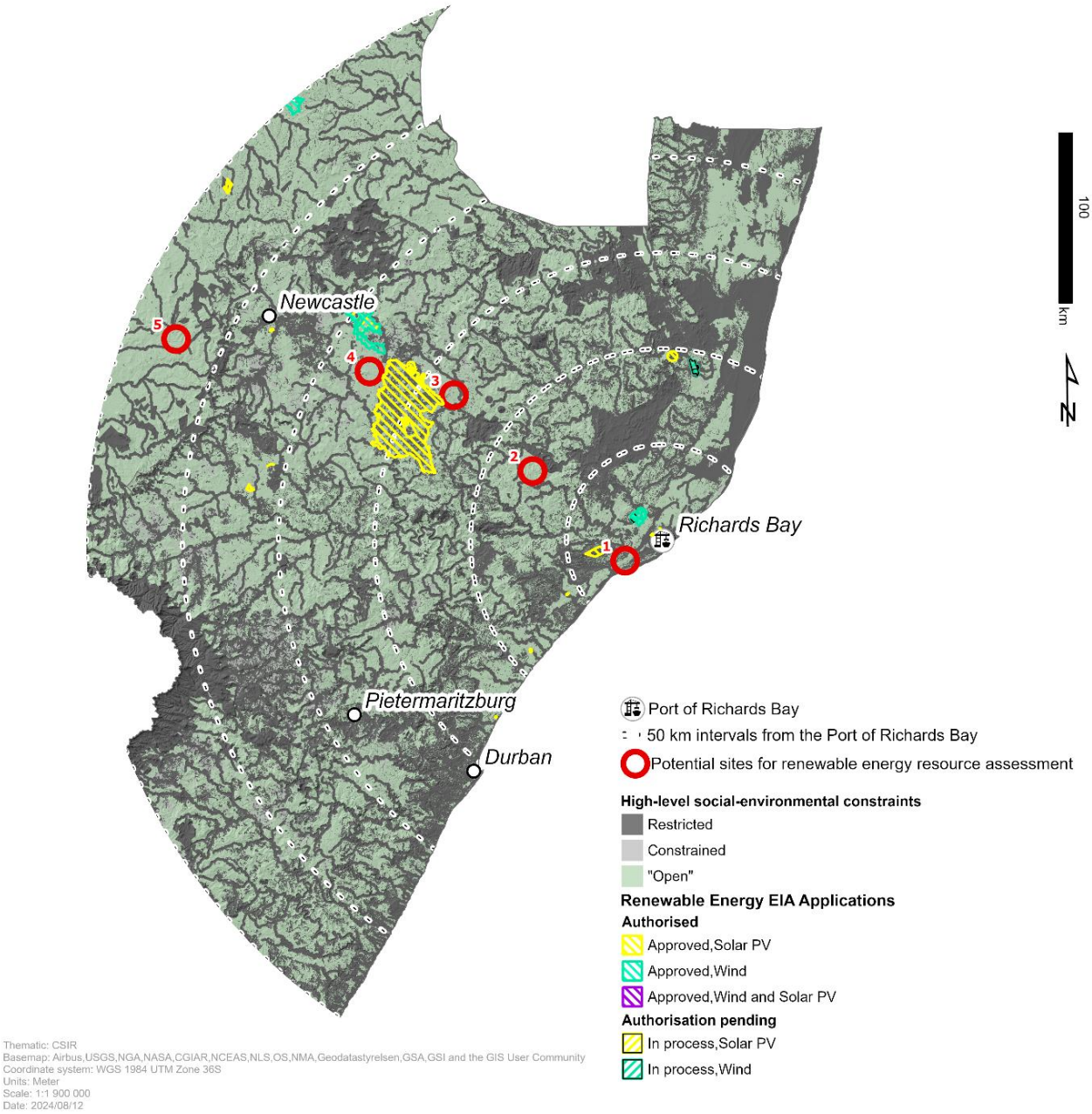
Site		Latitude	Longitude
1.	Richards Bay	-28.89090556	31.83866973
2.	Koningskroon	-28.46441561	31.35058586
3.	Surreyvale	-28.10228084	30.93948554
4.	Kingsley	-27.9829322	30.49420926
5.	Waterbult	-27.80844518	29.47586809

Figure 3: Key social-environmental features in the Richards Bay region



Note that not all features may be visible at the map's scale.
Source: own creation, for data sources refer to Appendix: Spatial data bibliography.

Figure 4: Selected sites for renewable energy resource assessment based on key social-environmental features in the Richards Bay region



Note that not all features may be visible at the map's scale.
Source: own creation, for data sources refer to Appendix: Spatial data bibliography

4.3 Coega

The Port of Coega is located approximately 25 km north-west of the City of Gqeberha in the Eastern Cape. The Graaff-Reinet regions is relatively constrained by protected areas (Figure 5). Overall, there seems to exist abundant unconstrained land from Gqeberha in a south-to-north-westerly corridor between Murraysburg and Willowmore. Quite a few RE facilities have been proposed in the region, presumably also driven by the presence of REDZ and EGI corridors (refer to Figure 1 and Figure 2).

Based on the high-level environmental screening, the following sites in the Coega region may be considered as potentially 'open' for RE and green hydrogen developments (Table 3).

Table 3: Potential sites for subsequent renewable energy resource assessment at Coega

Site	Latitude	Longitude
1. North of Gqeberha	-33.5906	25.48333
2. Kleinpoort	-33.3998	24.9339
3. Aberdeen	-32.7274	24.1806
4. Hofmeyr	-31.7535	25.78835
5. East of Aberdeen	-32.4287	23.22422

Figure 5: Key social-environmental features in the Coega region

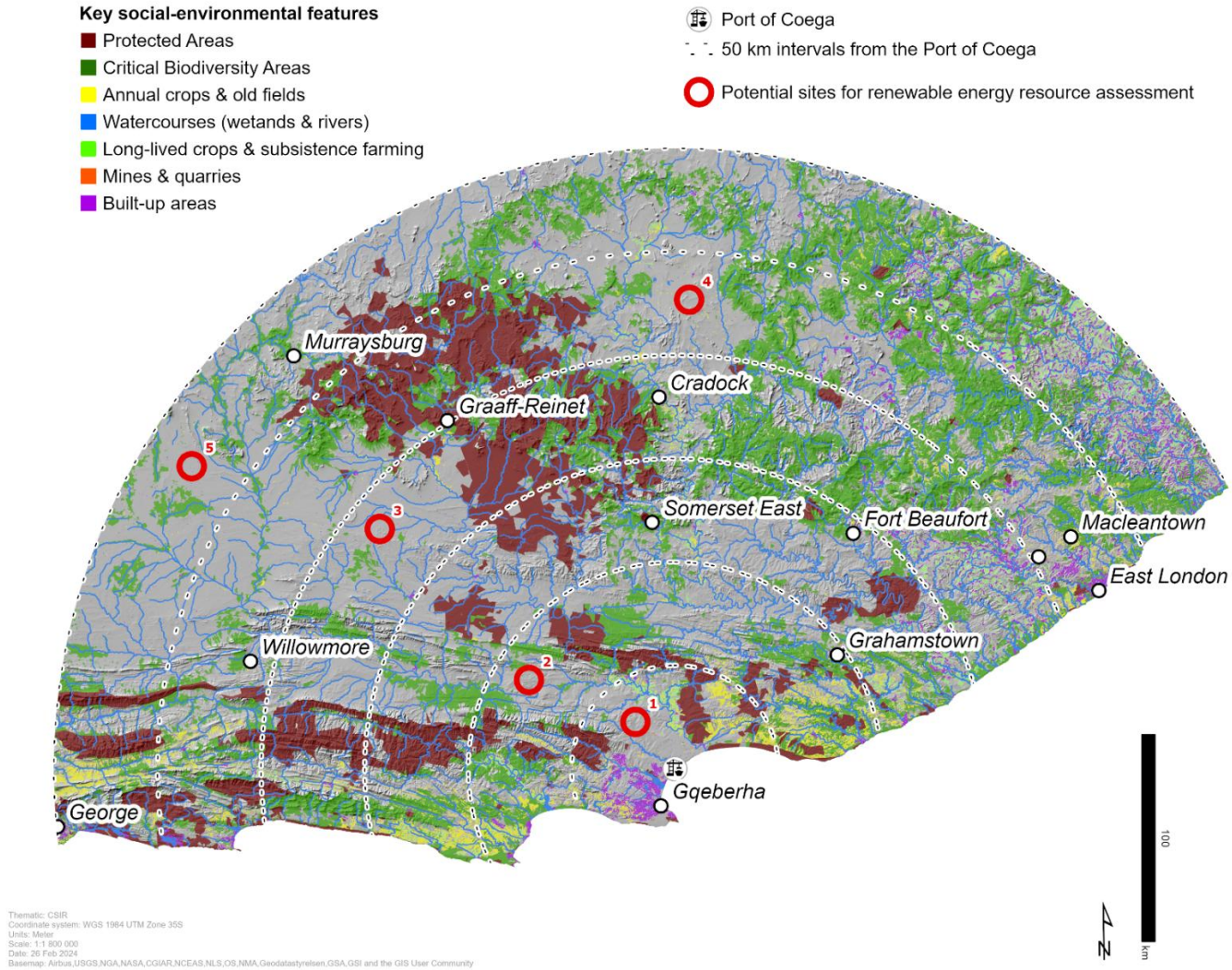


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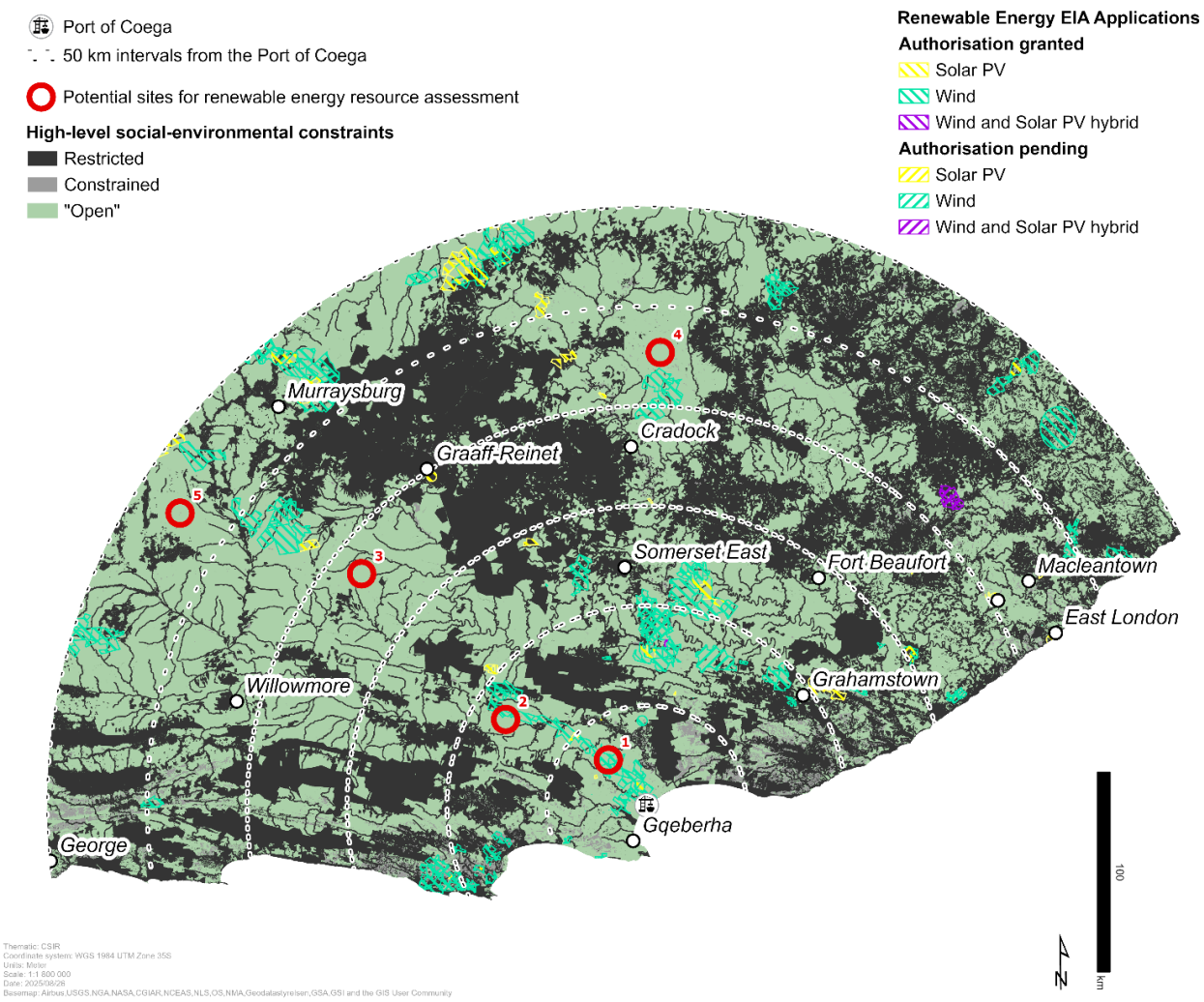
Figure 6: Selected sites for renewable energy resource assessment based on key social-environmental constraints of the Coega region



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4.4 Mossel Bay

In addition to Mossel Bay being a port location which provides opportunity for PtX production and export, it is also close to an existing Fischer-Tropsch (PetroSA) plant, which is approximately 12 km west of the town of Mossel Bay. The region between the coast and the Langeberg Mountain escarpment is constrained by agricultural fields, mostly planted pastures and annual crops that may co-exist with RE. Several protected areas exist in the region, often associated with mountain ranges (Figure 7). North of Oudtshoorn, beyond the Swartberg Mountain escarpment, areas available for RE development open up significantly, especially solar (see Figure 2). Several wind and solar RE development have been proposed in the Sutherland and Beaufort West areas. This is also evident from the number of RE development proposals in these areas (Figure 8). However, delivering electricity to the Mossel Bay area from the Karoo areas further inland would require extensive electricity transmission lines.

Based on the high-level environmental screening, the following sites in the Mossel Bay region may be considered as potentially 'open' for RE and green hydrogen developments (Table 4).

Table 4: Potential sites for subsequent renewable energy resource assessment at Mossel Bay

Site	Latitude	Longitude
1. Near Albertinia	-34.25684027	21.62363272
2. Near Van Wyksdorp	-33.81945097	21.53743191
3. Leeu Gamka / Prince Albert	-33.11098807	21.76026388
4. Beaufort West / Aberdeen	-32.42507306	23.21588464
5. Willowmore	-33.00965972	23.29772677

Figure 7: Key social-environmental features in the Mossel Bay region

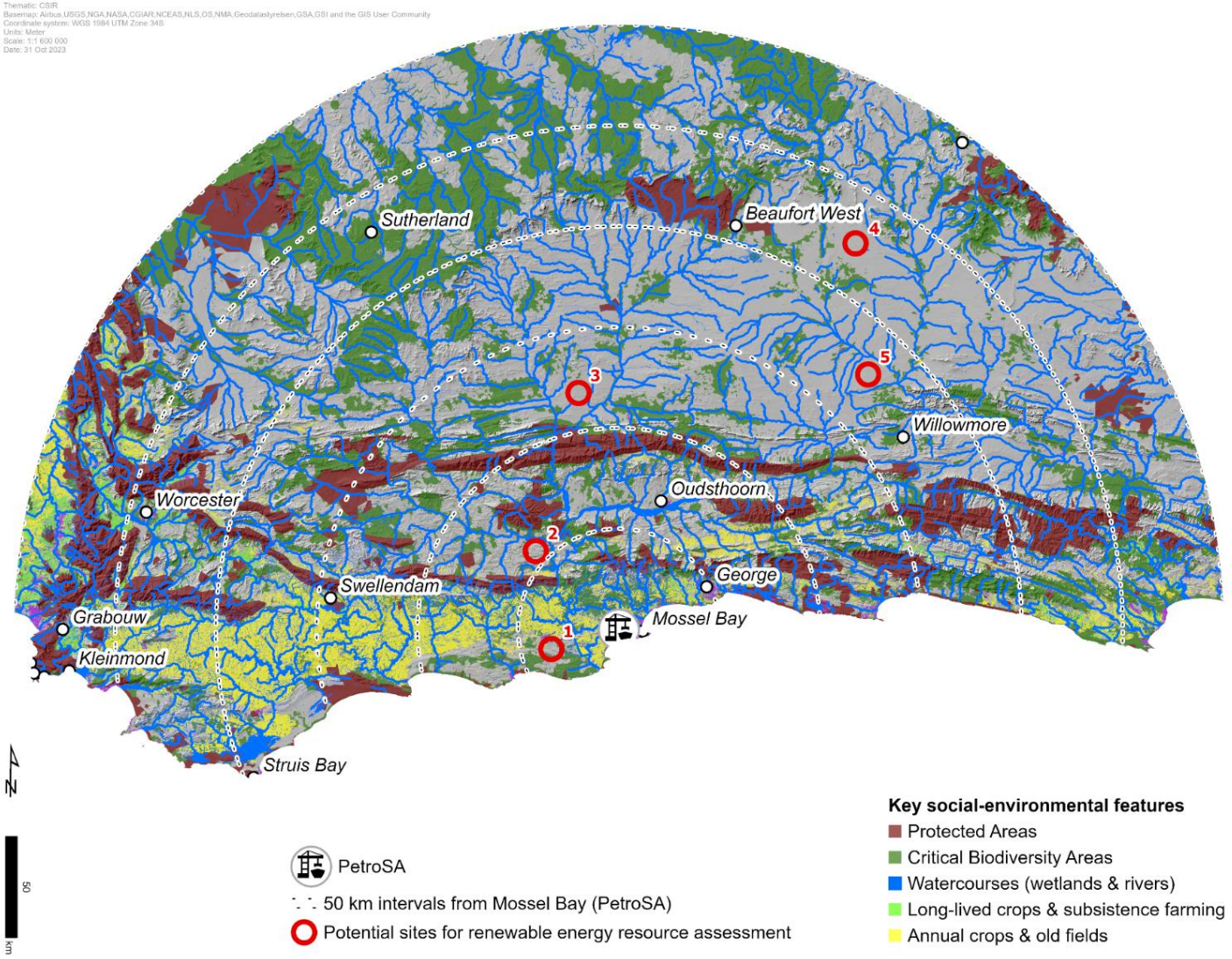

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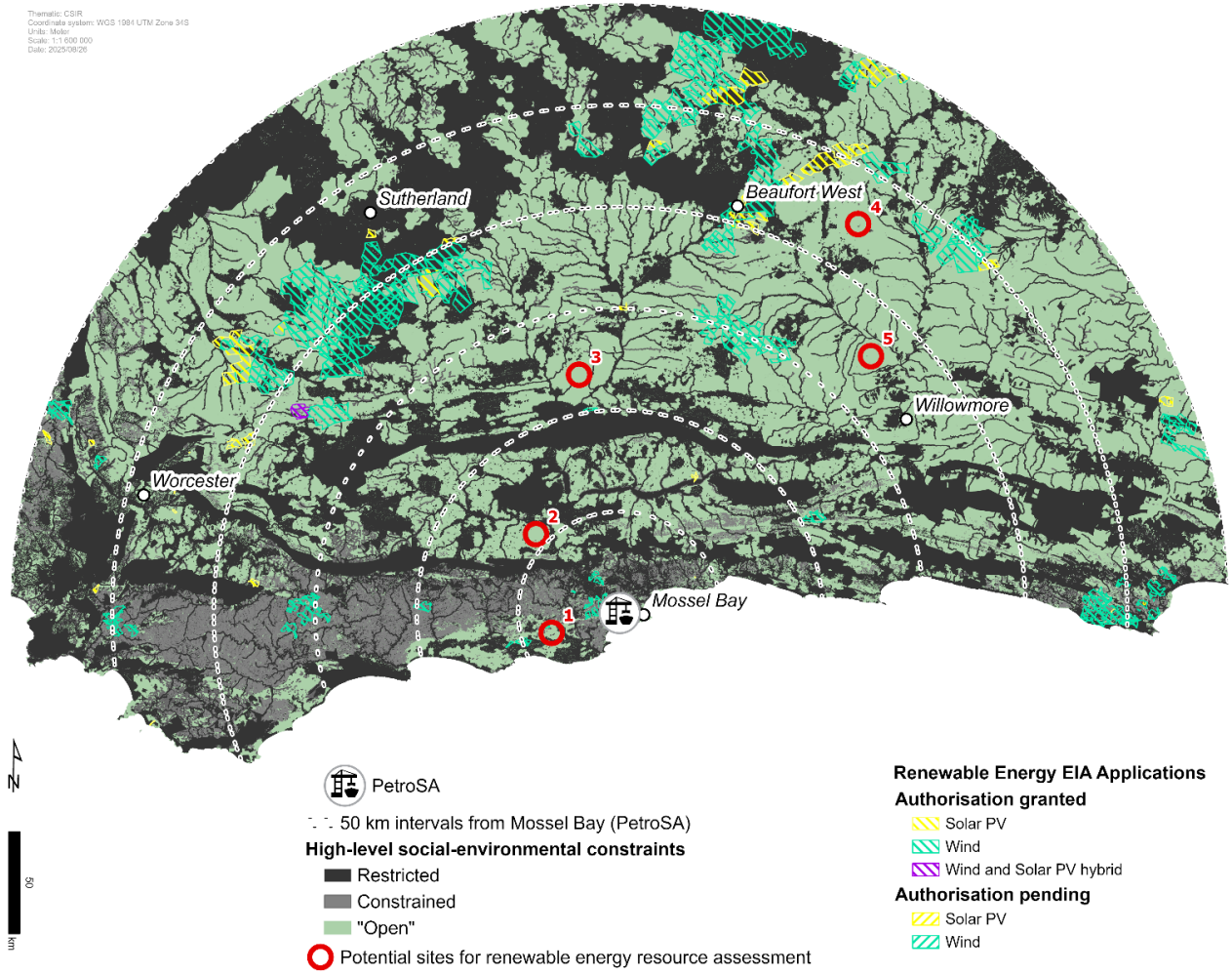
Figure 8: Selected sites for renewable energy resource assessment based on key social-environmental constraints of the Mossel Bay region



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4.5 Saldanha Bay

The Saldanha Bay area is extensively constrained by agricultural activities. Due to the extent to which agriculture has transformed natural landscapes in the Saldanha Bay region, many remaining areas, especially where fynbos and renosterveld vegetation is present, are either protected or identified as Critical Biodiversity Areas. The further one moves away from Saldanha Bay, the areas available for RE development open up significantly and RE resources, especially solar (refer to Figure 2), tend to increase. This is also evident from the number of RE development proposals in the area south of Sutherland. However, delivering electricity to Saldanha Bay from the areas further inland would require extensive electricity transmission lines.

Based on the high-level environmental screening, the following sites in the Saldanha Bay region may be considered as potentially 'open' for RE and green hydrogen developments (Table 5).

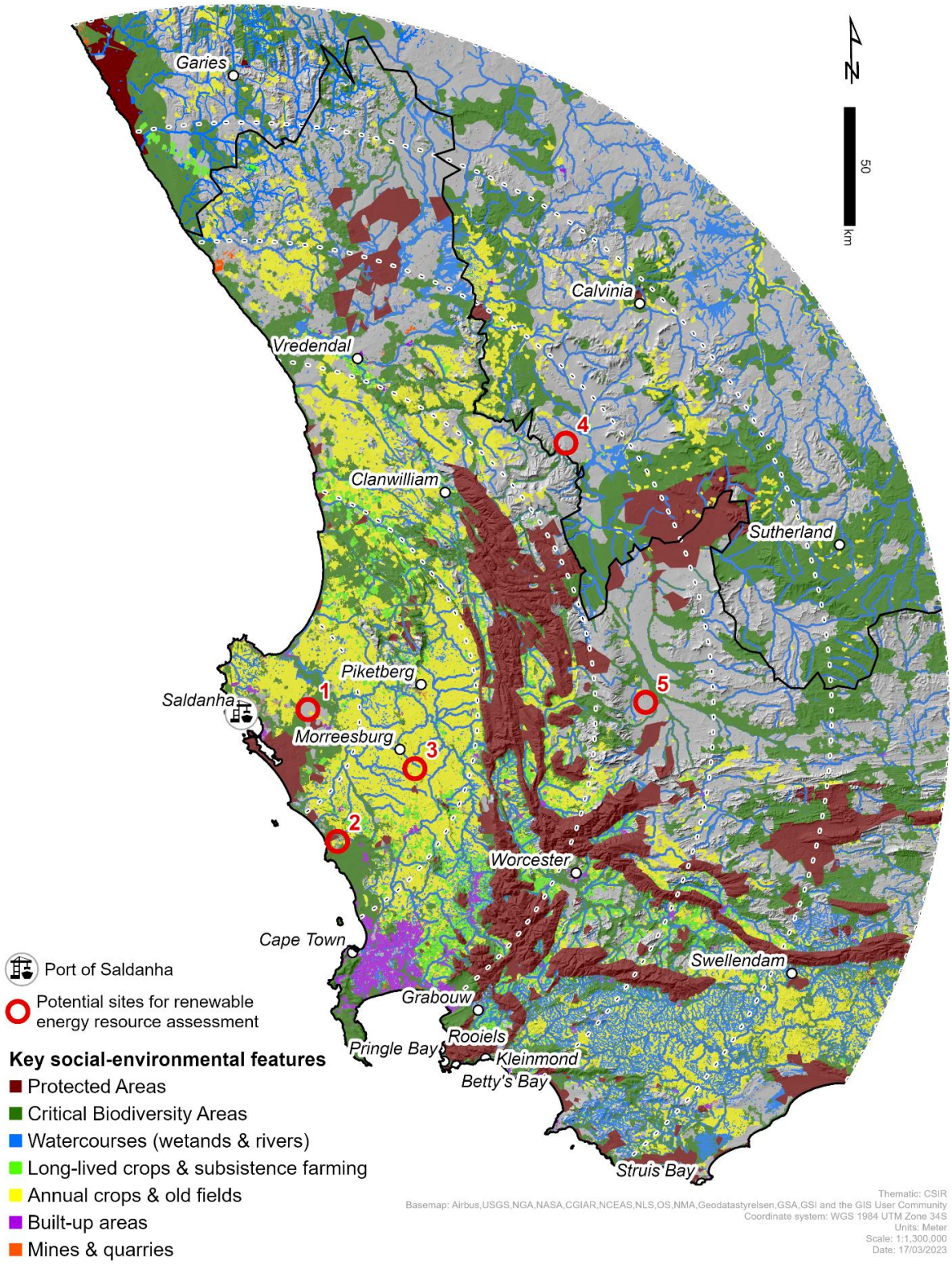
Table 5: Potential sites for subsequent renewable energy resource assessment at Saldanha Bay

Site	Latitude	Longitude
1. East of Saldanha Bay	-32.9932	18.24893
2. North of Cape Town, near Atlantis	-33.4990	18.36825
3. Near Morreesburg	-33.2284	18.72773
4. East of Clanwilliam	-31.9965	19.43567
5. Between Worcester & Sutherland	-32.9901	19.78011

Within the Saldanha Bay area, there are several approved and constructed RE facilities (e.g. West Coast One WEF1 north of Saldanha Bay, and the Hopefield WEF2 between Saldanha Bay and Morreesburg). However, it is understood that further development of WEFs in the direct vicinity of Saldanha Bay is largely constrained by military radar3. Therefore, Site 1 may not be considered feasible. Site 2, albeit 'open', may present challenges due to its proximity to Cape Town and its coastal settlements (that could result in visual impacts and social resistance), private nature reserves and tourism hotspots like the Atlantis Dunes. Both sites 1 and 2 have limited potential area (~ 8 500 ha and ~ 5 800 ha) and are boxed in by restricted areas.

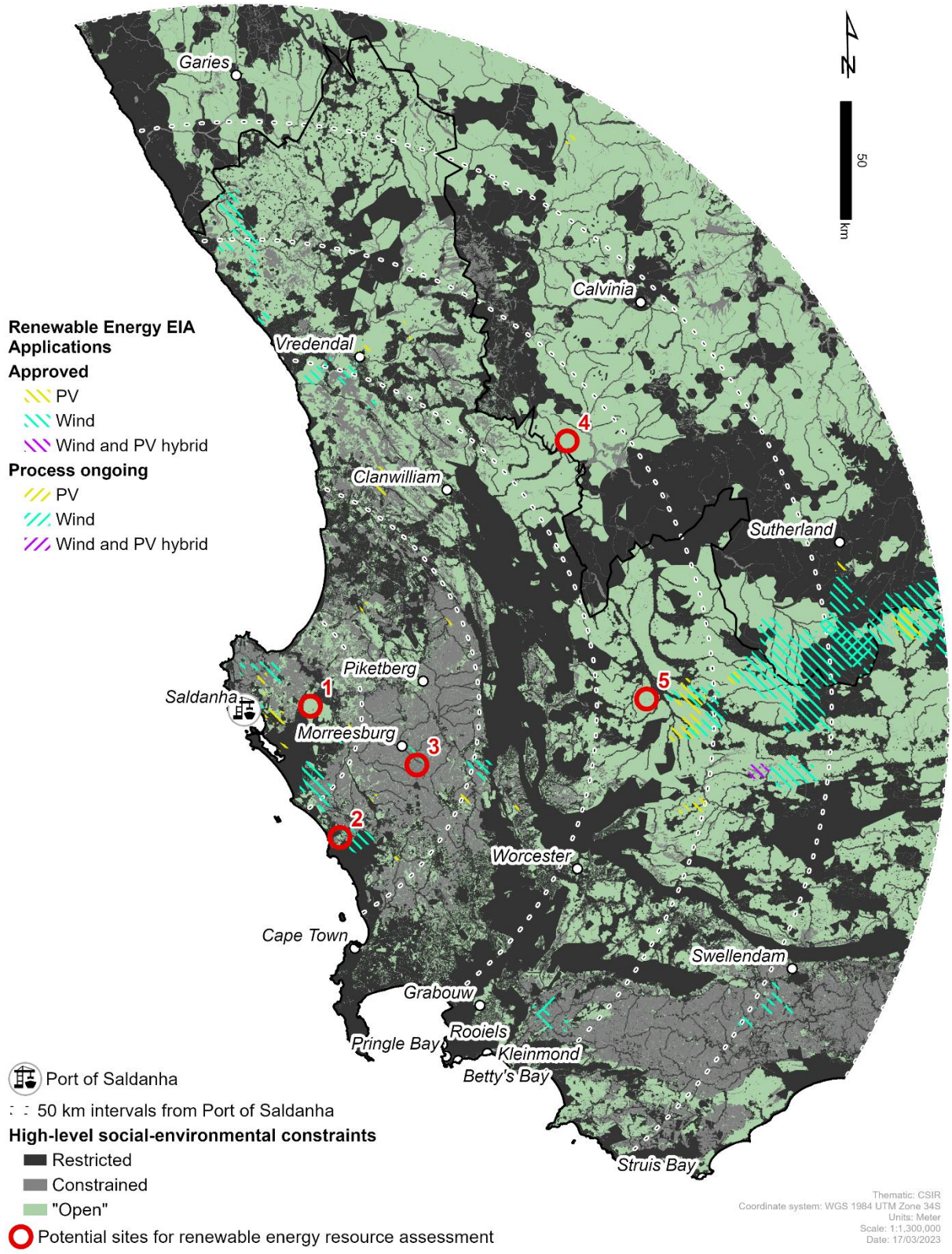
[1] https://www.windlab.com/our-projects/west-coast/
[2] https://azarigroup.com/project/hopefield-wind-farm/
[3] https://www.westerncape.gov.za/text/2006/7/2_report_1__executive.pdf

Figure 9: Key social-environmental features in the Boegoebaai region



Note that not all features may be visible at the map's scale.
Source: Own creation, for data sources refer to Appendix: Spatial data bibliography

Figure 10: Selected sites for renewable energy resource assessment based on key social-environmental constraints of the Saldanha Bay region



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4.5 Boegoebaai (proposed port)

The area of the Northern Cape where the Boegoebaai Special Economic Zone (SEZ) is being envisaged, is mainly constrained along the coast by mining activities interspersed with Critical Biodiversity Areas. Approximately 30 km east of the proposed Boegoebaai SEZ, the Richtersveld World Heritage Site (Protected Area) extends to the border with Namibia (Figure 11). The areas further inland (e.g. south and east of Springbok and Pofadder) areas available for RE development open up significantly and RE resources, especially solar (refer to Figure 2), tend to increase. This is also evident from the number of RE development proposals in these areas. However, delivering electricity to Boegoebaai from the areas further inland would require extensive electricity transmission lines.

Based on the high-level environmental screening, the following sites in the Boegoebaai region may be considered as potentially 'open' for RE and green hydrogen developments (Table 6).

Table 6: Potential sites for subsequent renewable energy resource assessment at Boegoebaai

Site		Latitude	Longitude
1.	East of Boegoebaai	-28.6989	16.74826
2.	Between Port Nolloth and Boegoebaai	-29.027	16.92691
3.	West of Springbok	-29.5267	17.22556
4.	North-east of Springbok	-29.3648	18.44129
5.	North-west of Garies	-30.3968	17.70413

Several renewable energy facilities are proposed in the region, including the 225 MW Richtersveld WEF and 75 MW Richtersveld Solar Farm, proposed by G7 Renewable Energies, which have been granted Environmental Authorisation (EA)[4]. The Renewable Energy EIA[5] Applications (REEA) database lists the entire affected land portions on which the RE development is proposed, which usually exaggerates the perceived development size. The solar farm's extent was planned at approximately 200 ha[6], and the wind farm potentially at up to 5 000 ha[7].

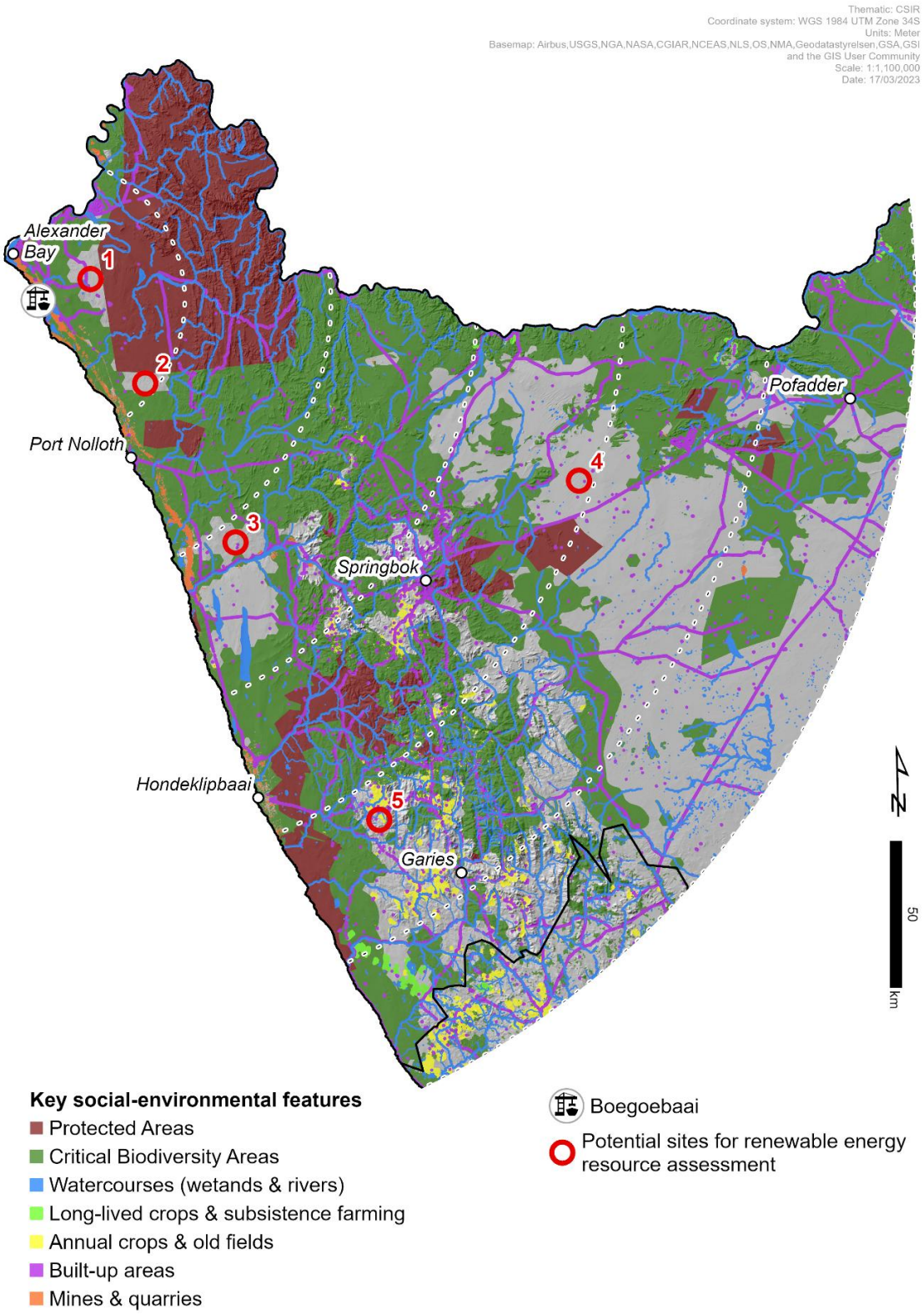
[4] DFFE. 2023. Renewable Energy EIA Applications Database

[5] EIA: Environmental Impact Assessment

[6] https://sahris.sahra.org.za/sites/default/fies/additionaldocs/RIC277.05%20Draft%20Scoping%20Report_Richtersv eld%20Solar%20Farm.pdf

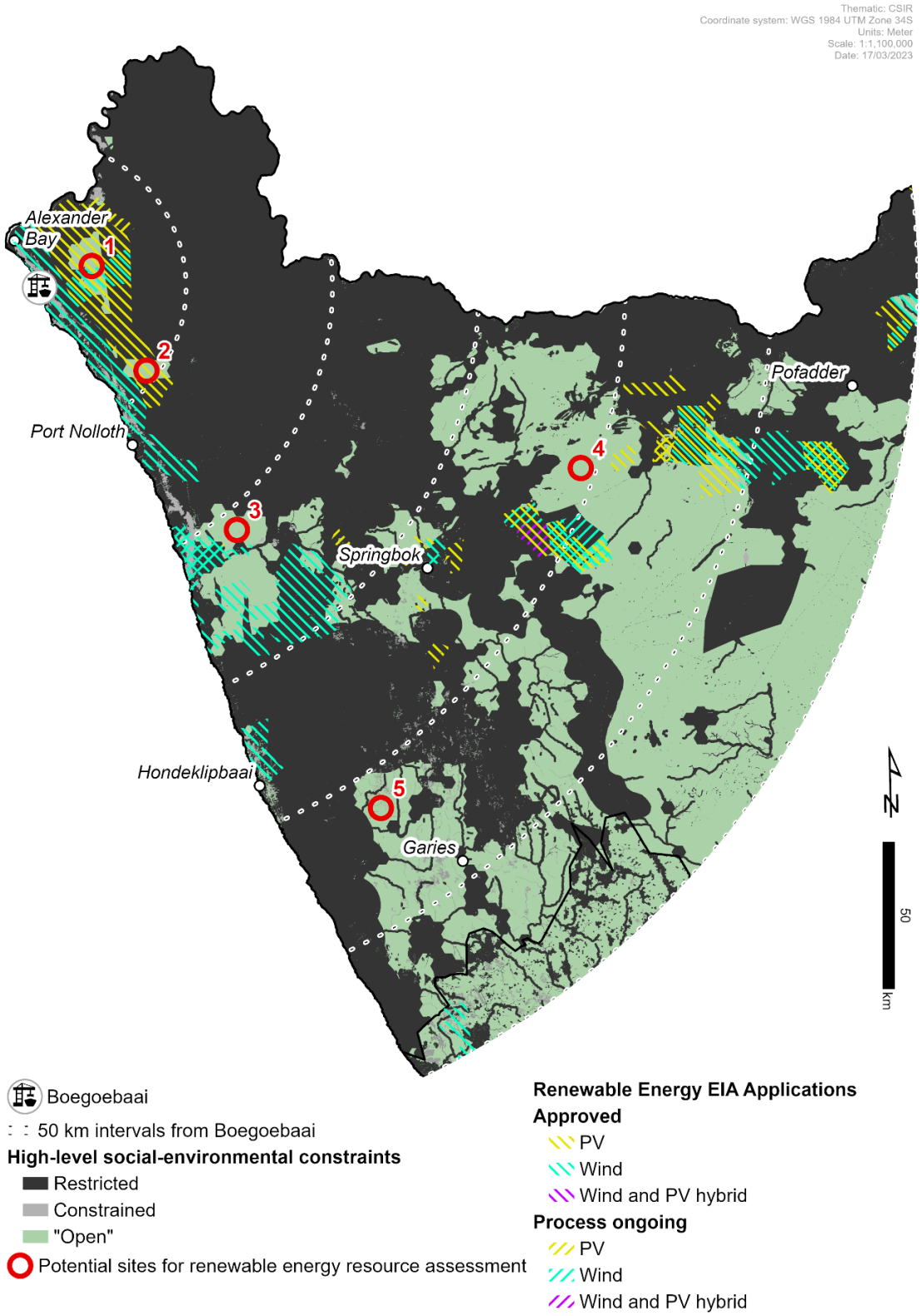
[7] https://sahris.sahra.org.za/sites/default/files/additionaldocs/Annex%20L%20-%20EMP.pdf

Figure 11: Key social-environmental features in the Boegoebaai region



Note that not all features may be visible at the map's scale.
Source: Own creation, for data sources refer to Appendix: Spatial data bibliography

Figure 12: Selected sites for renewable energy resource assessment based on key social-environmental constraints of the Boegoebaai region



Note that not all features may be visible at the map's scale.
Source: Own creation, for data sources refer to Appendix: Spatial data bibliography

5. Conclusion

The high-level constraints analysis is based on a spatial overlay of available data. It aims to provide an overview of potential areas that need to be avoided or may be constrained for new energy development, and to identify initial sites for subsequent resource assessment. In reality and/or at a finer scale, other opportunities and constraints may exist. Potential sites for solar and wind development were identified manually, primarily based on larger tracts of "open" (as far as possible) or "constrained" land. The list of identified sites is not exhaustive, and the sites cannot be considered as actually feasible from a technical, environmental or safety/social perspective (especially in the case of Wind Energy Facilities (WEFs)). The sites only aim to serve as a point of departure for further wind and solar resource assessment.

Environmental, procedural, and regulatory concerns are often the reason development project proposals are unsuccessful in receiving Environmental Authorisation and buy-in from civil society. ESS enable the pre-emptive consideration of environmental issues, flag potential environmental issues and fatal flaws, guide the selection of good site alternatives, identify future studies that would be required during the Environmental Impact Assessment (EIA) phase, and provide early feedback into siting and engineering design (Uhorakeye et al., 2024)

To navigate and manage the impacts of a GH2/PtX economy, H2.SA provides a comprehensive EIA guideline ((Schreiner et al., 2024)). This guideline provides hands-on best practice tips and recommendations for planning and conducting project-specific EIA, including an overview of useful tools and relevant regulatory background information. It is recommended to consult the guideline already during the pre-feasibility phase.

References

Department of Environmental Affairs (DEA). (2015). *Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa*. https://redzs.csir.co.za/

Latinopoulos, D., & Kechagia, K. (2015). A GIS-based multi-criteria evaluation for wind farm site selection. A regional scale application in Greece. *Renewable Energy*, *78*, 550–560. https://doi.org/10.1016/j.renene.2015.01.041

Messaoudi, D., Settou, N., & Allouhi, A. (2024). Geographical, technical, economic, and environmental potential for wind to hydrogen production in Algeria: GIS-based approach. *International Journal of Hydrogen Energy*, *50*, 142–160. https://doi.org/10.1016/j.ijhydene.2023.07.263

Sánchez-Lozano, J. M., Henggeler Antunes, C., García-Cascales, M. S., & Dias, L. C. (2014). GIS-based photovoltaic solar farms site selection using ELECTRE-TRI: Evaluating the case for Torre Pacheco, Murcia, Southeast of Spain. *Renewable Energy*, *66*, 478–494. https://doi.org/10.1016/j.renene.2013.12.038

Schreiner, G., Snyman-van der Walt, L., Heather-Clark, S., Van den Berg, S., Abed, R., Strong, A., Claasen, L., Russo, V., Mqokeli, B., & De Wet, B. (2024). *Managing the Impacts of a Green Hydrogen/Power-to-X Economy: An Environmental Assessment Guideline for South Africa*. https://greenhydrogensummit.org.za/wp-content/uploads/2025/04/Green-Hydrogen_EIA_Guideline.pdf

South African National Biodiversity Institute (SANBI). (2017). *Technical Guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning* (A. Driver, S. Holness, & F. Daniels, Eds.; 1 (Beta Version)). SANBI.

Uhorakeye, T., Takolia, E., Roos, T., Snyman-van der Walt, L., Schreiner, G., & Uehlecke, H. (2024). *A Practical Guide to Developing Sustainable Green H2/PtX Projects in South Africa*. https://greenhydrogensummit.org.za/wp-content/uploads/2025/04/Practical-Guide-to-Developing-_15April25_digital.pdf

World Bank Group. (2024). *Integrated Environmental & Social Sensitivity Mapping: Guidance for Early Offshore Wind Spatial Planning.* www.worldbank.org

Appendix: Spatial data bibliography

Protected Areas

Department of Forestry, Fisheries and the Environment. 2023. SAPAD: SA Protected Areas Database. Incremental Release, SAPAD Quarter 3, 2023. [https://egis.environment.gov.za/data_egis/data_download/current]

Critical Biodiversity Areas

CapeNature. 2017. 2017 Western Cape Biodiversity Spatial Plan (WCBSP). [http://bgis.sanbi.org/Projects/Detail/194]

Eastern Cape Department of Economic Development, Environmental Affairs and Tourism. 2019. Eastern Cape Biodiversity Conservation Plan (ECBCP). [http://bgis.sanbi.org/Projects/Detail/233]

Northern Cape Department of Environment and Nature Conservation. 2016. Northern Cape Critical Biodiversity Areas. [http://bgis.sanbi.org/Projects/Detail/203]

City of Cape Town. 2017. Terrestrial Biodiversity Network. [https://odp-cctegis.opendata.arcgis.com/datasets/cctegis::terrestrial-biodiversity-network-1/about]

Eastern Cape Department of Economic Development, Environmnetal Affairs and Tourism. 2019. Eastern Cape Biodiversity Conservation Plan (ECBCP). [http://bgis.sanbi.org/Projects/Detail/233]

Ezemvelo KZN Wildlife. 2012. 2012 KwaZulu-Natal Systematic Conservation Plan (KZNSCP). [https://bgis.sanbi.org/Projects/Detail/27]

Watercourses

South African National Biodiversity Institute. 2018. South African Inventory of Inland Aquatic Ecosystems (SAIIAE). [http://bgis.sanbi.org/Projects/Detail/217]

Agriculture

Department of Agriculture, Forestry and Fisheries. 2015. Field crop boundaries.

Land cover

Geoterraimage. 2021. South African National Land Cover (SANLC) 2020. [https://sfiler.environment.gov.za:8443/ssf/s/readFile/folderEntry/40904/8afbc1c77a484088017a4df272650044/1624802518000/last/SA_NLC_2020_ALBERS.tif.vat.zip]

Renewable energy development proposals

Department of Forestry, Fisheries and the Environment. 2022. REEA: Renewable Energy EIA Applications Database. REEA Quarter 4, 2022. [https://sfiler.environment.gov.za:8443/ssf/s/readFile/folderEntry/56010/8afbc1c784b965710186c6fb2ecf38fd/1678373341483/last/REEA_OR_2022_Q4.zip]