CHAPTER 6

Infrastructure and Planning

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Integrating Authors:	Johan Maritz[1], Jabulani Jele[1], Nonjabulo Malinga[1], Elsona van Huyssteen[1], Michelle Audouin[1]

[1] *CSIR*

Recommended citation: Maritz., J., Jele, J., Malinga, N., van Huyssteen, E. & Audouin, M. (2026). *Chapter 6: Infrastructure and planning* in Schreiner, G., Mqokeli, B., Snyman-van der Walt, L., Lochner, P. & Tsedu, R. (eds.). (2026). *Work Package 2: Strategic Environmental Assessment for the Proposed Boegoebaai Port, Special Economic Zone and Namakwa Region*. CSIR/SPLS/Ems/EXP/2026/0001/A, CSIR: Pretoria: ISBN 978-0-7988-5676-8. Available at Boegoebaai Port | CSIR

Executive Summary

This chapter evaluates the implications of the proposed Boegoebaai Port and SEZ development, with a focus on three key risk areas: (1) Development Planning and Regulatory Capacity, (2) Settlement Infrastructure Development and Management, and (3) Construction of Economic Infrastructure. The assessment considers three scenarios; Baseline, Small Green Hydrogen, and Large Green Hydrogen, to identify risks, assess severity, and propose mitigation measures. The key risk areas and mitigation recommendations can be summarised as:

1. Development Planning and Regulatory Capacity

Baseline: Existing planning demand is low. Current mechanisms such as the District Municipal Tribunal are sufficient for limited applications.

Small Green Hydrogen: A sharp increase in land-use applications is expected, particularly in Richtersveld. Without new capacity, institutions will be unable to manage high volumes, and delays may arise from complex land ownership and CPA-related issues. Risk severity: severe without mitigation.

Large Green Hydrogen: Regional infrastructure projects (green energy, pipelines, new rail) will sustain high pressure across several municipalities. The risks remain severe if not addressed. Risk severity: severe without mitigation; moderate with mitigation.

Mitigation Recommendations can be summarised as:

- Establish a strengthened planning support mechanism at district/provincial level to manage high volumes of land-use applications and related planning decisions.
- Build municipal planning capacity, including dedicated planners, to ensure effective processing and compliance, and
- Develop clear, coordinated processes for securing servitudes and addressing communal land ownership disputes.

2. Settlement Infrastructure Development and Management

Baseline: Limited growth is occurring, with incremental pressures in Pofadder, Aggeneys, and Springbok. Infrastructure conditions remain largely unchanged elsewhere.

Small Green Hydrogen: Settlement pressure will increase sharply, particularly in Port Nolloth and Alexander Bay, driven by construction workers, in-migration, and port- and SEZ-related activities. Social services and bulk infrastructure (water, sanitation, electricity) will be under significant strain. Risk severity: severe without mitigation; moderate with mitigation.

Large Green Hydrogen: Sustained demand across multiple towns, with Richtersveld and secondary towns facing high growth. Without intervention, service breakdowns, informal settlement growth, and inequality risks rise. Risk severity: severe without mitigation; moderate with mitigation.

Key mitigation recommendations include:

- Prioritise bulk service upgrades (water, sanitation, electricity) in Port Nolloth and Alexander Bay
- Strengthen municipal financial viability and planning to manage settlement growth

- Focus housing and service delivery in nodal areas to reduce informality and concentrate resources, and
- Align social infrastructure investments (schools, clinics, waste facilities) with settlement growth patterns.

3. Construction of Economic Infrastructure

Baseline: Roads (R382, N7, N14) currently experience low traffic volumes and routine maintenance. No pipelines or rail infrastructure are present, with only minor Eskom upgrades underway.

Small Green Hydrogen: Multiple simultaneous projects (port, SEZ, pipelines, transmission, renewable energy) will create severe pressure on transport, land, and resource systems. Key risks include deterioration of the R382 from heavy vehicle traffic, high demand for construction materials and water, and accommodation of large construction workforces. Risk severity: high to severe.

Large Green Hydrogen: Risks escalate with additional rail and pipeline development. Land acquisition, servitude processes, and environmental impacts will be complex. Heavy traffic will further strain regional roads. Risk severity: severe without mitigation; moderate with mitigation.

Key mitigation recommendations identified:

- Shorten maintenance cycles on the R382 and secure sustainable budgets for upkeep
- Implement systematic monitoring of road conditions to enable timely intervention
- Coordinate land acquisition and servitude processes across agencies (rail, pipelines, transmission)
- Develop guidelines for construction camps in collaboration with municipalities to avoid overburdening local services, and
- Monitor and plan for water demand associated with construction, including borehole use and licensing

In summary, the successful implementation of the Boegoebaai Port and SEZ development will require substantial enhancements in municipal planning capacity, settlement service delivery systems and coordinated infrastructure management (also see section 7.6.5). Without mitigation, risks range from moderate to severe across all three key areas, with the most acute pressures expected in land-use planning capacity, settlement services, particularly water and sanitation, and transport infrastructure. With targeted mitigation, risks may be reduced to moderate only where institutional, financial and infrastructure measures are implemented as preconditions in advance of peak development phases. In particular, development planning support mechanisms, water and sanitation upgrades, municipal service protection measures, land access protocols and road rehabilitation requirements must be operational before the relevant phases of development proceed. Where these enabling measures are not demonstrably secured, the development pathway should be regarded as carrying moderate to severe strategic risk.

The scenarios therefore highlight the importance of early planning, coordinated land access, cumulative infrastructure planning and investment in bulk services as conditions precedent for enabling the Port and SEZ to contribute to sustainable regional development.

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Definitions

The following reflects a number of selected definitions applicable to this section:

Breaking New Ground (BNG)	The Department of Human Settlements is mandated with the implementation of Breaking New Ground (BNG) Developments, formally known as Reconstruction and Development Programme (RDP) Developments. BNG provides fully subsidised houses to low-income families. (Urban4Site, 2024)
Core regions	Refers to the four local municipalities that comprise the SEA study area region namely Richtersveld, Nama Khoi, Kamiesberg, and Khai-Ma.
District Municipal Tribunal (municipal cooperation)	A District municipality may, with the agreement of the local municipalities within the area of such district municipality, establish a Municipal Planning Tribunal to receive and dispose of land development applications and land use applications within the district municipal area (Department of Rural Development and Land Reform (DRDLR) , 2013)
Electricity Grid Infrastructure (EGI)	Electricity Grid Infrastructure (EGI) is a term used to describe the network of transmission lines and stations that deliver electricity to consumers.
Green Energy (GE) Site	A green energy (GE) site refers to a location where renewable energy sources are harnessed and utilized. In the context of the Boegoebaai study these sources include solar and wind.
Green Hydrogen (GH_2)	GH_2 typically refers to Green Hydrogen, which is hydrogen produced through the electrolysis of water using renewable energy sources.
Greenfields development	Greenfield development refers to constructing new infrastructure or developments on previously unused land. Greenfield development presents a blank canvas, allowing planners and developers to design and build structures from scratch (Energylink, 2023).
Integrated development planning and plan	The planning instrument and process set in place by the Municipal Systems Act, 2000 (MSA), to enable coordinated service delivery and development between the three spheres of government and other role players within a municipal area, to 1) improve quality of life, 2) support sustainable development and transformation, and 3) facilitate democratic and multi-sector planning processes. The municipal Integrated Development Plan (IDP) addresses current and future societal needs within the context of social and ecological systems in which they exist. All project and activities related to infrastructure, land development, service delivery, and land and environmental management within any area needs to form part of the relevant IDP and associated sector plans and infrastructure investment frameworks.
Interim Protection of Informal Land Rights (IPILRA)	The Interim Protection of Informal Land Rights Act, 31 of 1996 (IPILRA), is a temporary but repeatedly extended law that protects people who hold informal or customary land rights from being deprived of those rights without their consent. Prior consent of informal right-holders is needed if a development would deprive or significantly infringe their land rights.
Land development	SPLUMA defines land development as the "*erection of buildings or structures on land or the change of use of land, including township establishment, the subdivision or consolidation of land or any deviation from the land use or uses permitted in terms of an applicable land use scheme*" (Department of Rural Development and Land Reform (DRDLR) , 2013, p. 13).
Land use	SPLUMA defines land use as the purpose for which land is or may be used lawfully in terms of a land use scheme, existing scheme or any other authorisation, permit or consent issued by a competent authority, and includes any conditions related to such land use purposes. This could be related to "zoning" in the traditional sense (Department of Agriculture, Land Reform and Rural Development, and Department of Planning, Monitoring and Evaluation, 2021).
Land use management	Land Use Management is the system of legal requirements and regulations that apply to land in order to achieve desirable and harmonious development of the built

	environment (Department of Rural Development and Land Reform (DRDLR) , 2013).
Local access roads	In the context of this report, these are any direct access roads used to access green energy installations, power lines, and pipelines. They also include any roads built in formal settlements developed to accommodate workers or to access informal settlements resulting from the in-migration of aspirant job seekers.
Municipal planning governance	The planning function undertaken by a municipality to manage land development within the municipal area.
Municipal service delivery	Delivery of housing, electricity and basic services such as water and sanitation, to which South African citizens have a constitutional right.
Municipal Spatial Development Framework (MSDF)	The objective of the Municipal SDF is to guide the spatial distribution of current and future land uses, infrastructure investment, development, and protection of the natural environment, considering financial realities, whilst giving effect to the vision, goals and objectives of the Municipal Integrated Development Plan (IDP). The SDF is intended to show desired patterns of land use, directions for future growth, indicate the alignment of Urban Edges, and depict special development areas, at a municipal level as well as local level. The impact of the SDF is limited to providing policy to guide and informing land development and management (Saldanha Bay Municipality, 2025)
National Development Plan	The NDP is seen as a guiding document for South Africa. It was released in 2011 and is positioned as a blueprint for tackling South Africa's challenges. In 2012, Cabinet adopted the NDP as a long-term vision and plan for the country. (National Science and Technology Forum, 2019).
Notified Maximum Demand	The Notified Maximum Demand (NMD) is the capacity in kVA, measured over a 30-minute integration period, per point of delivery/supply that the customer requests and Eskom contractually agrees to make available during all periods (ESKOM (a), 2024).
National Spatial Development Framework	A national spatial planning instrument with a long-term horizon that (1) is mandated by the Spatial Planning and Land Use Management Act, 2013 (SPLUMA), (2) has to be aligned with the National Development Plan (NDP), and (3) is adopted by Cabinet as official national spatial development policy for implementation throughout the country. As such, it provides: (1) an overarching spatial development framework including a set of principle-driven spatial investment and development directives for all three spheres and sectors of government, meaning 'where, when, what type, and how much to invest and spend throughout the country'; and (2) a set of strategic spatial areas of national importance from an ecological, social, economic and/or ICT or movement infrastructure perspective to be focused on and targeted by government and the private sector in the pursuit of strategic national development objectives and/or the prevention or mitigation of national crises (Department of Agriculture, Land Reform and Rural Development, and Department of Planning, Monitoring and Evaluation, 2021).
Renewable Energy Development Zones (REDZs)	Renewable energy development zones, essential for the development of large-scale wind and solar photovoltaic facilities. (Department of Forestry, Fishing and Environment, 2024a). REDZs are zones in which large-scale renewable energy development would be considered most appropriate based on environmental, social and economic factors (McEwan, 2017).
Regional infrastructure	This includes all national, provincial, and district roads, railway lines, power lines, water, and gas pipelines used to access and pass through the area. Road, rail, and pipelines are the main modes of transport considered for freight to and from the harbour and SEZ.
Renewable Energy Independent Power Producer Procurement (REIPPP) Programme	An initiative by the South African government aimed at increasing electricity capacity through private sector investment.
Regional Spatial Development Framework.	SPLUMA provides for the establishment of a planning instrument to enable focused temporal and spatial coordination of governance and investment actions in and between different spheres of government, within areas with unique but interrelated attributes or development challenges that span more than one municipality and/or

	province (Van Hyussteen, et al., 2016, p. 5).
Settlement	A settlement refers to a place where people live, work, study, play and relax. A settlement can range in size from a small number of dwellings grouped together, to a large city or groups/conglomerations of cities tied together through dense transport and communication networks (Department of Agriculture, Land Reform and Rural Development, and Department of Planning, Monitoring and Evaluation, 2021).
Spatial planning	This is the term used to describe a high level planning process that is inherently integrative and strategic, that takes into account a wide range of factors and concerns and addresses the uniquely spatial aspects of those concerns (South African Government, 2001).
Strategic Environmental Assessment (SEA)	Strategic Environmental Assessment (SEA) is a systematic process for evaluating the environmental consequences of policies, plans, and programs at an early stage of decision-making, alongside economic and social considerations (European Union, 2025).
Special Economic Zone (SEZ)	An area with different business and trade laws from the rest of the country. SEZs are located within a country's national borders, and their aims include increasing trade balance, employment, increased investment, job creation, and effective administration.
Strategic Integrated Project (SIP)	Projects designated as SIPs need to be of significant economic or social importance to the Republic, contribute substantially to any national strategy or policy relating to infrastructure development, or be above a certain monetary value determined by the PICC. (Infrastructure SA, 2024)
Spatial Planning and Land Use Management Act (SPLUMA)	SPLUMA is “The Spatial Planning and Land Use Management Act 16 of 2013” and came into operation on 1 July 2015. SPLUMA is a national framework act that requires provincial legislation to enable municipalities to enact spatial planning and land use management by-laws. The municipal SPLUMA by-laws prescribe how land use applications and appeals are dealt with. (Farrell, 2017)
Strategic Transmission Corridors	Important for planning electricity transmission and distribution infrastructure and for following the procedure for applying for environmental authorisation for electricity transmission and distribution expansion in these corridors. (Department of Forestry, Fishing and Environment, 2024b)
Sustainable settlement development	This term refers to the processes of planning for, investing in, and governing human settlements in such a way that they are economically vibrant, spatially and socially integrated, self-generating, safe and overall sound places to live in. It also includes using resources to achieve these characteristics that are cognisant of the cumulative needs of current and future generations (Van Hyussteen, et al., 2016, pp. 18-6).
Town	A place (1) where people, economic activities and social services are geographically concentrated in a distinct and identifiable area, (2) that has a legally enshrined form of local/municipal government (Department of Agriculture, Land Reform and Rural Development, and Department of Planning, Monitoring and Evaluation, 2021)
Township	This term has two meanings in the South African context. Firstly, it is a colloquial name given to residential townships which were established during the Colonial and Apartheid Eras for temporary occupation by Black South Africans on the outskirts of towns and cities, and where only the most basic of amenities and infrastructure were provided. During colonial times, these townships were called “locations”, and sometimes still are, albeit increasingly less so. Secondly, it is the legal name given to new human settlements and extensions to existing settlements in planning legislation, e.g. ‘Sunnyside Extension 3’, dating back to the first Town National Spatial Development Framework 2022 21 Planning Ordinances passed in the early 1900s, and also appearing in the more recent Spatial Planning and Land Use Management Act (2013) (SPLUMA) (Department of Agriculture, Land Reform and Rural Development, and Department of Planning, Monitoring and Evaluation, 2021).

CHAPTER 6. INFRASTRUCTURE AND PLANNING

6.1 INTRODUCTION AND SCOPE

6.1.1 Sustainable Infrastructure development in support of the Boegoebaai Port and SEZ development

The proposed port and Special Economic Zone (SEZ) development is located within the Richtersveld Local Municipality. The core region, as defined in this SEA, comprises several local municipalities, including Richtersveld, Nama-Khoi, Kamiesberg and Khai-Ma. This core area is also situated within a broader region which experiences several challenges including vast distances between sparsely populated settlements, arid and dry climate (featuring water scarcity), limited socio-economic services and social facilities. The region is facing increased outmigration, especially by younger people seeking opportunities in other parts of the country (DBSA, 2024). These challenges pose a risk to the long-term future of the area. At the same time there are many growth opportunities which can be unlocked through investment that has to confront the higher costs associated with the challenge of the vast geography and climate. The region has several natural endowments which give the area a distinct advantage compared to other regions in South Africa and many other regions globally. Over and above the unique landscape and tourism potential, the two significant natural endowments which have not been fully initiated up to this point include: i.) The west coast ocean with its ocean economy opportunities and deep harbour potential; and ii.) Optimal sun radiation for solar power generation; and iii.) The area also has good wind energy potential in places. The Boegoebaai Port development is part of the proposed "green hydrogen" economy in South Africa. The project is designated as a Strategic Integrated Project (SIP) under the National Development Plan (NDP). Sasol is leading the feasibility studies for the proposed development under a Memorandum of Understanding (MoU) with the Northern Cape Economic Development Agency (NCEDA) (Namakwa District Municipality, 2022), while TRANSNET has undertaken several investigations for the proposed port. The preceding associated feasibility studies are acknowledged as components of the broader policy and planning context; however, they do not predetermine or constrain the findings or recommendations of this assessment.

The receiving environment in the context of the Boegoebaai SEA comprises the Richtersveld and three surrounding municipalities: Nama-Khoi, Kamiesberg, and Kai-Ma. A strong focus is placed on the Richtersveld municipality as the recipient of the port and SEZ investment along with the majority of its associated development components. This chapter adopts a regional cumulative assessment that spans infrastructure elements, including induced settlement expansion and related secondary development, instead of limiting the analysis to a narrow project envelope. This broader approach ensures that key features that are affected by, or that substantially influence, the proposed development are taken into account.

The core region (illustrated in Figure 6-1) consists of large open areas of shrubland, natural rock, and bare patches; it features a diverse landscape that transitions from flat, sandy coastal plains to jagged, sharp mountains of volcanic rock and the lush banks of the Orange River, which forms the border with neighbouring Namibia. Within this setting are several small settlements as well as zones primarily dedicated to coastal and riverine mining. The region also hosts several protected areas, national parks, and a UNESCO World Heritage site. Mountainous areas extending from north to south, particularly through the Richtersveld Municipality, play a significant role in shaping settlement patterns and infrastructure provision. Figure 6-1 further illustrates the site designated for the new port and SEZ.

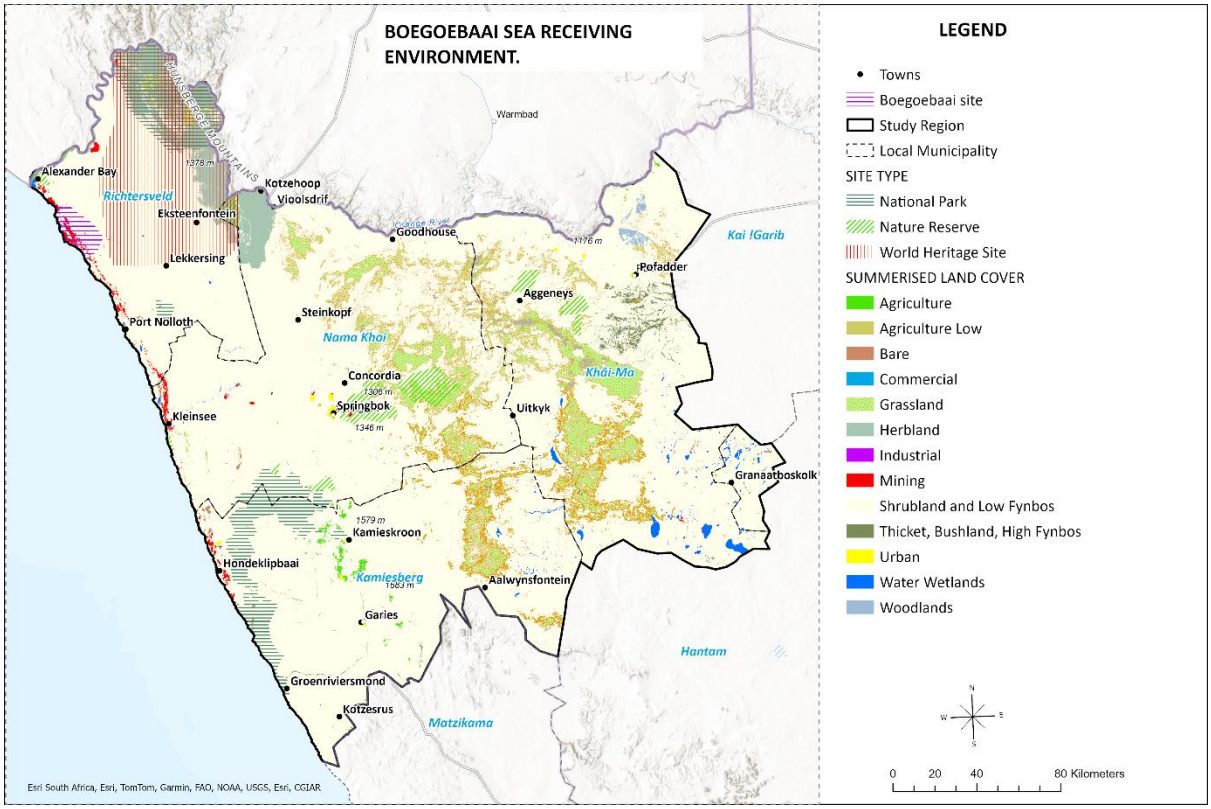


Figure 6-1: Broad receiving environment comprising land utilisation, settlement, and summarised land cover reflection.

(Source: (EGIS, 2022)

Existing infrastructure, including water lines, power lines, roads, and settlements (not reflected in the map), will be impacted by the proposed development. Various landowners will also be affected by the establishment of new infrastructure, modifications to existing infrastructure, or the expansion of existing facilities settlements. The range of infrastructure-related items required to produce the proposed port and SEZ development, as well as the range of associated stakeholders, increases the complexity of the planning landscape and necessitates that an integrated and participatory approach to planning be a strong requirement of this initiative.

Since the introduction of Spatial Planning Land Use and Management Act in 2013 (introduced to create a more **uniform, equitable, and efficient** system for spatial planning and land use across all spheres of government), and in alignment with a series of pronouncements by the Constitutional Court since 2010, the responsibility for land use change approvals lies with the local municipality. The decisions of national or provincial departments cannot overturn those of the municipality. Therefore, it is emphasised that an applicant can only successfully commence development when all required regulatory approvals have been granted. SPLUMA is now used alongside other related planning legislation, such as NEMA (National Environmental Management Act), to ensure consistency, uniformity, and alignment with other legislation on land management (AWARD, 2017).

6.1.2 Scope of this Chapter

This chapter explores the potential implications of the proposed Boegoebaai Port and SEZ development for the Richtersveld municipality and surrounding region. The issues considered include the infrastructure components consisting of the following: 1) critical infrastructure corridors that serve the port and sez, including electricity, water, roads, a rail line (proposed), and green energy distribution (network); 2) settlement development; and 3) associated municipal service delivery and implications for spatial planning and land use management. The study incorporated a review of relevant literature and documentation, complemented by site visits to the region. Consultations were held with municipal and district officials, as

well as key infrastructure stakeholders including NCEDA, Department of Water and Sanitation, ESKOM and SANRAL, etc.

Short and longer-term implications, risks and possibilities for mitigation are outlined within the context of 1) the set of development principles and priorities, as well as, 2) the institutional realities focussed predominantly on the municipal and district spatial planning and integrated development planning and governance system, which is primarily aimed at supporting intergovernmental alignment to facilitate effective service delivery, job creation, transformation of apartheid legacies and long term sustainability.

At the same time, it is crucial to recognise that land, infrastructure and settlement development often are the result (and the spatial footprint) of complex socio-economic and socio- ecological systems. Therefore, despite focusing on planning and infrastructure components, this chapter does not stand alone, as other related aspects are also included, such as terrestrial ecology and conservation planning, socio-economics (which encompasses tourism and governance aspects), and coastal livelihoods. This section should also be viewed along with other sections of this report that feature the social, economic, population and migration dynamics. (please also see Chapter 7 of the SEA, Atkinson et al., 2026).

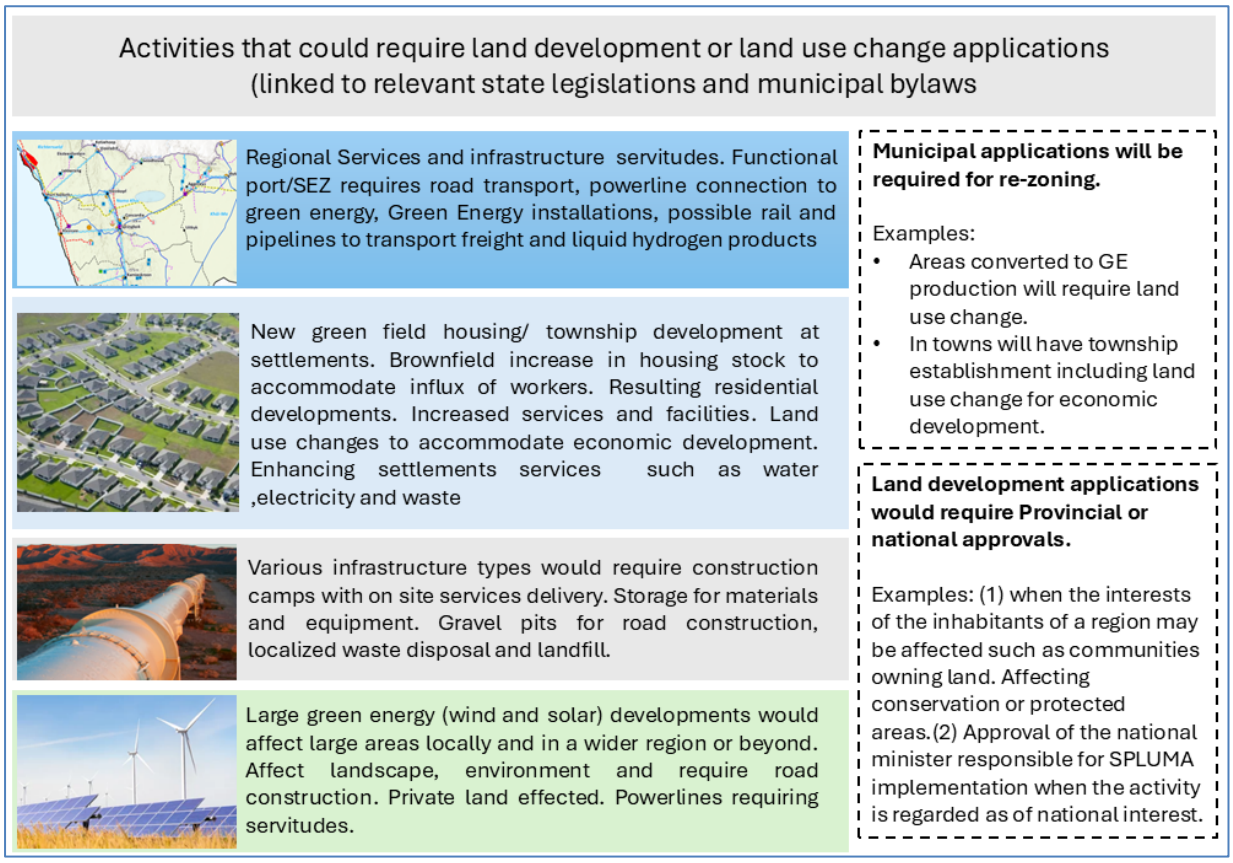


Figure 6-2: Activities that could typically require land development and land use change applications in the study area.

Source: (Van Hyussteen, et al., 2016) adjusted by authors.

The focus on hydrogen within the port and SEZ significantly impacts realisation timelines, scale, location, cost, and associated effects due to a complex regulatory framework for securing rights. Numerous development activities linked to the Boegoebaai port and SEZ could affect current land use and future development. Proposed activities may necessitate land use changes, development applications (see Figure 6-2) and EIAs in accordance with relevant regulations. This chapter highlights implications for settlement development, regional infrastructure, and spatial planning, while also considering tourism, agriculture, and conservation. Furthermore, ensuring sustainable benefits for local communities is crucial for success, particularly in this impoverished region.

This chapter is structured as follows:

- **Baseline Environment Description (Section 6.2):**

  This section outlines the current state of the region, excluding the proposed port and SEZ developments. It focuses on existing settlement patterns, key infrastructure challenges, and regional planning dynamics. Development opportunities within the current trajectory are also highlighted.

- **Potential Impacts and Management (Section 6.3):**

  This section describes anticipated impacts of the proposed port and SEZ developments. It considers major infrastructure components, potential effects on settlements, and implications for spatial planning, land use management, and governance.

- **Risk Assessment (Section 6.4):**

  This section identifies key risks associated with development pressures, settlement impacts, and the construction of large-scale proposed projects. It introduces a methodology for evaluating risks and opportunities, supported by risk matrices that illustrate the potential consequences across major risk themes.

- **Management Guidelines and Monitoring Requirements (Sections 6.5 and 6.6):**

  This component outlines strategic actions to address identified risks. It focuses on high-level management priorities and monitoring needs to ensure effective mitigation.

- **Knowledge Gaps (Section 6.7):**

  Despite the identification of key planning and infrastructure risks, uncertainties remain. This section highlights areas requiring further research or detailed analysis to fully understand the potential impacts of the proposed developments.

6.1.3 The importance of Integrated Inter-governmental Development Planning

Given that the integration of planning, budgeting, and implementation in South Africa remains essential, the process has been slow, uneven, and challenging (Pieterse et al., 2016; Oranje & Van Huyssteen, 2011). The context of the proposed Boegoebaai development underscores the need for an integrated planning approach that addresses the hardships of distance, inaccessibility, and limited options, particularly for 1) historically marginalised groups who resided in areas impacted by Apartheid policies before 1994, 2) rural municipalities with limited resources where state spending typically drives the local economy, like Richtersveld, and 3) ecologically vulnerable regions. The area proposed for the port and SEZ is ecologically sensitive, with extensive conservation zones, and includes several under-resourced municipalities as noted in the Auditor-General's 2023 reports. Each municipality relies heavily on grants to supplement its limited revenue base. Financial and performance reporting across these municipalities was consistently poor, with systemic challenges in data accuracy and accountability. Furthermore, all reported skills shortages, hampering their ability to effectively perform key municipal functions (Auditor General, 2023).

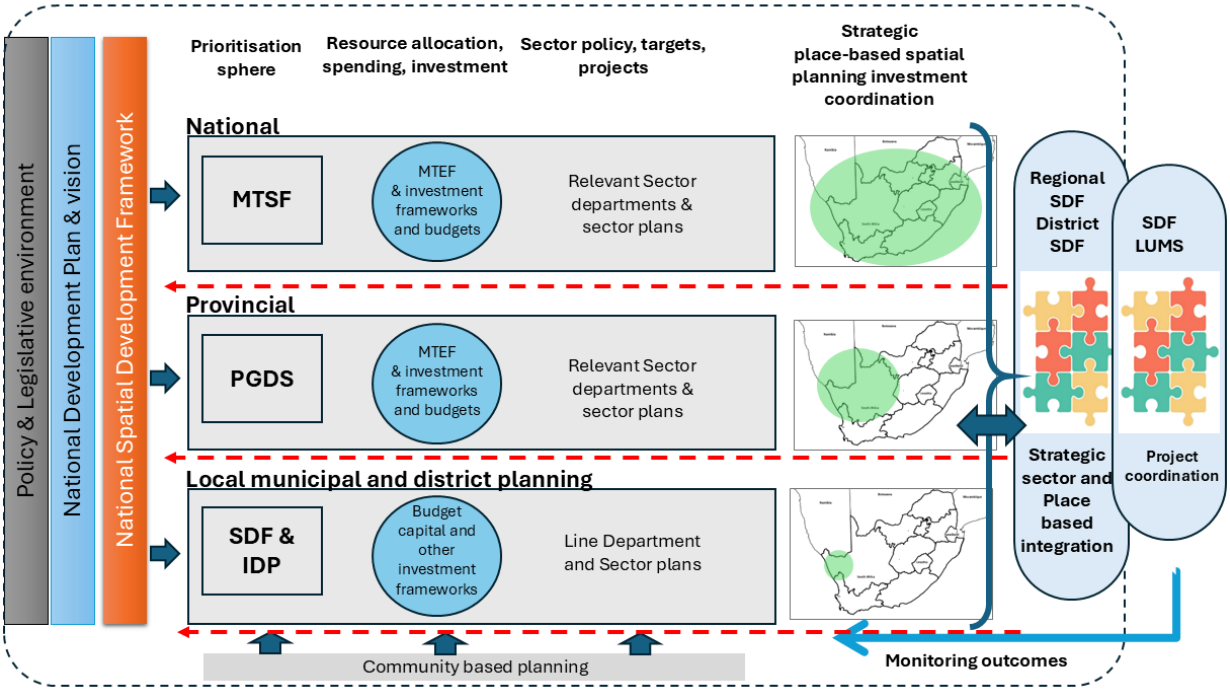


Figure 6-3: Highlight the specific roles of national, provincial, district and local planning instruments in sequencing port, SEZ and associated infrastructure.

Source: (Van Hyussteen, et al., 2016, pp. 18-13), modified by authors.

It is imperative that careful, coordinated, and integrated planning must be conducted. The opportunities and challenges for coordinated inter-governmental planning become even more evident when considering the wide array of spatial and integrated development planning and governance instruments (graphically illustrated in Figure 6-3), all of which requires annual review, adaptation, and alignment relevant to the study area. This can include the following:

- Integrated and strategic national, local, and regional plans,
- The Richtersveld Spatial Development Framework (Erioloba Consulting, 2024), which, given that it is the focal region for the proposed development, represents a critical guiding planning document.
- Integrated Spatial Development Frameworks (SDFs) to guide spatial development across national, provincial, regional, local, and precinct scales, see SPLUMA and the Department of Rural Development and Land Reform's SDF Guidelines (Southworth, 2017).
- Integrated provincial and municipal sector plans, i.e. integrated housing plans, integrated transportation plans, and integrated disaster management plans.
- Integrated investment frameworks, i.e. Integrated Infrastructure Investment Framework (provincial and municipal), Capital Investment Framework (municipal), and spatially targeted budgeting instruments introduced by National Treasury; and
- Land use management schemes, which are largely established for towns and generally require support to develop across the full extent of the municipal area, along with assistance to ensure alignment with SDFs and to prepare relevant by-laws to guide development.

While it is both 1) legally mandated and 2) evident from the situation on the ground that government needs to establish an enabling and guiding context for development and investment in the region through effective proactive and coordinated planning, budgeting, and targeted investment and governance, the risks and mitigations associated with the potential impact of the proposed port and SEZ development on

land, infrastructure, and settlements could in many respects also be addressed through such proactive planning and associated implementation.

In the context of the proposed Boegoebaai Port and SEZ, integrated planning must also be understood as a legal and institutional requirement rather than only a good planning principle. This includes alignment with SPLUMA principles of spatial justice, sustainability, efficiency, resilience and good administration; the Municipal Systems Act requirements for credible IDPs and sector alignment; and the NEMA principles of precaution, environmental justice, cooperative governance and the consideration of cumulative effects in decision-making. The chapter should therefore be read as supporting coordinated implementation through IDPs, SDFs, land use schemes, infrastructure investment frameworks, environmental authorisation processes and intergovernmental coordination mechanisms relevant to the region.

6.2 DESCRIPTION OF BASELINE ENVIRONMENT

This section summarises the dynamic baseline concerning the Planning and Infrastructure elements identified in this report. The dynamic baseline, Scenario 0, represents the region and its current development path without the construction of the Boegoebaai Port and the associated SEZ. While this proposed development is not included in this scenario, it doesn't prevent other initiatives from taking place in the region. Therefore, for this scenario, we assume that other major development projects will proceed as scheduled within the region. The discussion begins with an overview of current municipal development planning and management in the area.

6.2.1 Municipal Development Planning and Management

Land use and settlement trends in the Namakwa region are notably distinct, predominantly characterised by rural and peri-urban settings, with few towns displaying features of growing urban environments (Tshani Consulting, 2023). It is essential to prioritise settlement planning to ensure vital elements are addressed, thus enabling the establishment or expansion of functional communities to meet anticipated developmental growth requirements.

The governance capacity is already limited in the local and district municipalities in the Namakwa SEA (Strategic Environmental Assessment) region for coordinated and aligned spatial and infrastructure investment planning and management, including the mitigation of any new activities in their areas of jurisdiction. The complex institutional context for service delivery and the associated roles and responsibilities in South Africa, often negotiated at local and district municipal levels, adds an additional challenge and requires dedicated capacity and support for the relevant municipalities.

The municipalities of Nama Khoi, Khai-Ma, Richtersveld, and Kamiesberg have stable councils with no vacant councillor positions and regular meetings. However, Nama Khoi and Kamiesberg lack key management roles such as Technical Managers and Project Management Unit (PMU). These positions are crucial for operational tasks, as well as for strategic planning and improved grant access. A shortage of skilled personnel affects service efficiency. Only Richtersveld and Kamiesberg adopted the Framework for Infrastructure Delivery and Procurement Management, with Richtersveld utilizing 100% of its infrastructure budget for 2023/24, while others spent less than 80%, leading to budget roll-overs and concerns about infrastructure delivery (DBSA, 2024).

The context of the region, characterised by its vast geography—sparse settlements spaced by large distances, an arid climate leading to water scarcity, a small and slowly growing population, low levels of education and skills, as well as outmigration—results in a more limited scale of economic development that also impacts spatial and development planning across its four municipalities. Furthermore, the infrequent planning and development-related activities, combined with a restricted financial base, hinder the appointment of full-time planners.

Municipalities face common challenges related to development, spatial and economic planning, characterised by a lack of essential planning staff, dedicated units, and geographic information system (GIS) personnel. Although most municipalities have approved Integrated Development Plans (IDP), Service Delivery and Budget Implementation Plans (SDBIP), Spatial Development Frameworks (SDF), and a

promulgated Land Use Management (LUM) scheme, these are often compliance focussed with varying degrees of contextual innovation and alignment with provincial and environmental plans. The following table reflects the extent of compliance with critical spatial planning documents and planning functions.

Table 6-1: Spatial Planning and Functions, 2024

No	Municipality	IDP	SDBIP	LUM	SPLUMA	SDF	MPT	LED unit	GIS unit
1.	Richtersveld	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
2.	Kamiesberg	Yes	Yes	No	Yes	review	Yes	Yes	No
3.	Khai-Ma	Yes	Yes	No	Yes	review	Yes	Yes	No
4.	Nama Khoi	Yes	Yes	No	Yes	review	Yes	Yes	No

(DBSA, 2024, p. 17).

The Namakwa District Municipal Planning Tribunal (NDMPT) is currently the main mechanism for making decisions on land use and land development applications received by the municipalities. The exception to this is when a municipality official is authorised to consider and make decisions on certain, specific land use applications (Poswa, 2024). The NDMPT is constituted of 16-19 members meeting quarterly. Annexure B presents a gazetted notice for the NDMPT. The current district municipal tribunal and municipal planning systems seem adequate for handling the present volume of development and land use applications. However, if there is a sharp increase in applications, their capacity could become a strategic limitation.

6.2.2 Settlement dynamics

The study area is an arid region that has contributed to low population numbers and density due to the harsh climate with low rainfall and limited water resources. Limited, or in some cases declining, economic opportunities have resulted in small, sparse settlements spread over large distances. Determining and projecting the growth of settlements is critical for establishing the baseline and identified scenarios.

Two primary sources of recent population data are utilised in regional planning documents: Statistics SA Mid-Year Estimates (prior to the 2022 census) and the 2022 census. The 2022 census was selected for this SEA as it offers a more current perspective on the region's population. The SEA team acknowledges the discrepancies between these two sources; however, state entities consider limited alternatives acceptable. A notable surge in population growth rates was identified when comparing the Statistics SA 2021 mid-year estimates to the 2022 census, which appeared excessive given the preceding population trend data. To address this issue, growth in residential structures was used as an alternative method for calculating population growth. Downscaled settlement data from the CSIR and residential structures data were utilised to provide a more precise estimate of the current growth rate per settlement. Analysing the changes in residential structures across all settlements reveals that growth associated with settlements varies significantly throughout the region. Overall, settlements in the region experienced growth of less than two percent per annum, with only a handful showing higher growth rates (refer to Table 6-2).

Table 6-2: Increase in settlement structures

Municipality	Municipal growth	Towns/ settlements	Per annum growth (2015-2022)1

[1] Some might be from a small base (small number of residents)

Kamiesberg	1.2%	Koingnaas	More than 10% pa
		Soebatsfontein	2.6%
Khai-Ma	2.2%	Aggeneys	4.3%
		Poffadder	3.4%
Nama Khoi	0.8%	Kleinsee	3.6%
		Springbok	7.5%
		Vioolsdrift	More than 10% pa
Richtersveld	1.7%	Alexander Bay	More than 10% pa

Source: Calculations by authors.

Overall, the low growth rates across most settlements signify the region's depressed state. Moreover, diamond mining in the Richtersveld is on the decline, resulting in reduced employment levels, which further limits opportunities in the area. These patterns do not consider the potential effects of new development. Significant investments, like a new port and SEZ, could attract attention to the area, potentially leading to substantial changes in settlement dynamics. The skills needed for the proposed developments might prompt an influx of people, contributing to growth in several settlements. Annexure A details all settlements in the region, their growth rates based on historic structural growth, and projected populations for 2030 and 2050.

Most settlements in this area are small, with populations under 5,000 residents. Port Nolloth is the only settlement within the Richtersveld Municipality housing more than 5,000 residents. In the broader region, only Steinkopf and the cluster of settlements around Springbok are larger. The remaining areas consist of smaller settlements. Population growth rates are derived from the increase in residential structures.

As outlined in the 2024 Partner-a-District diagnostic assessment by the DBSA (DBSA, 2024), two out of five residents in the Namakwa District live in poverty, highlighting the region's ongoing difficulties. While over 93% of households reside in formal homes, there exists a housing backlog in these municipalities; the National Housing Needs register reveals a backlog of more than 9,000 houses. Although the primary responsibility for housing lies with national and provincial government, local municipalities play a critical supporting role by planning for the provision of serviced stands. This responsibility must be integrated into their planning and policy frameworks, including the Human Settlements Plan, Informal Settlement Upgrading Strategy, Land Protection Policy, Land Alienation Policy, and Anti-Land Invasion Strategy. These instruments ensure alignment between strategic housing goals and practical land use management at the local level.

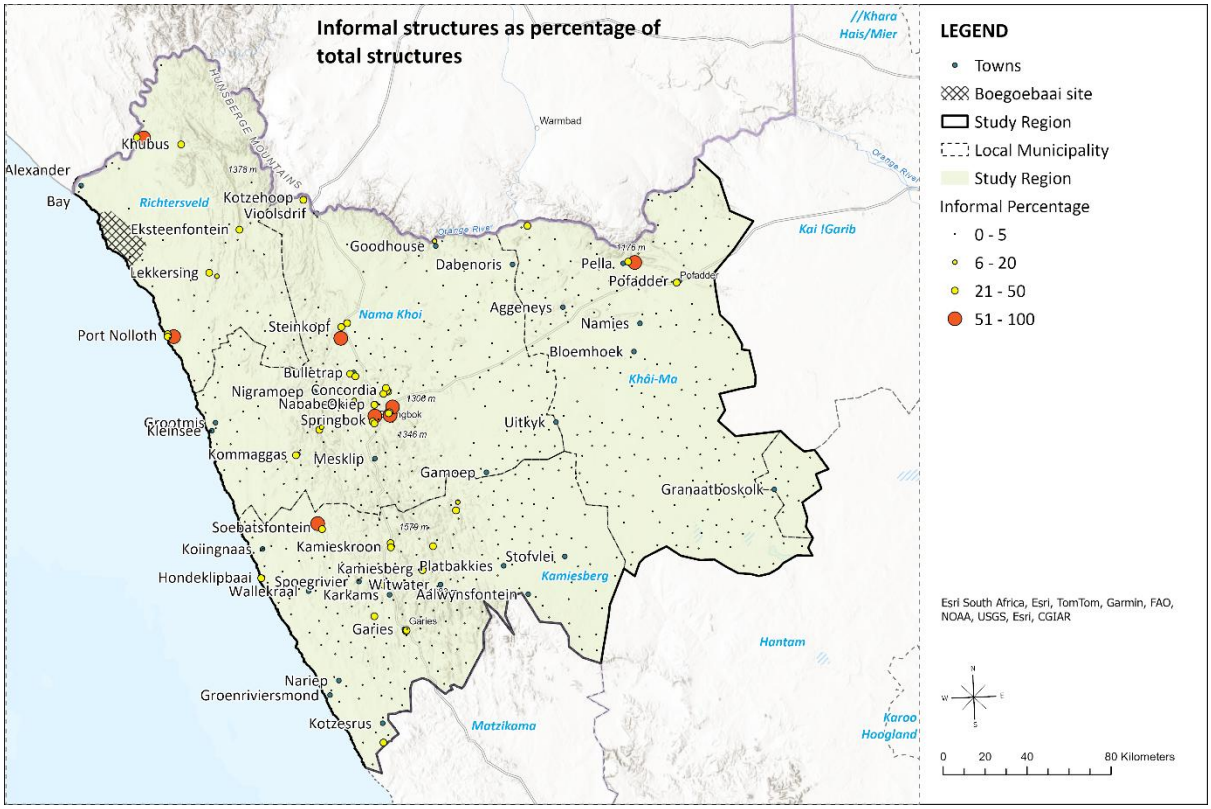


Figure 6-4: Extent of Informal structures.

Source: (Maritz, 2022)

The lack of serviced stands and the slow or non-existent expansion of urban areas contributes to these backlogs. This situation poses a risk of informal settlements arising in high-risk areas where dangers such as floods, fires, and erosion can further jeopardise residents. Related challenges include outdated sector plans, illegal occupation of municipal property, poor housing construction, and financial and infrastructure risks. The Northern Cape's Housing Construction Project will build 448 'Breaking New Ground' houses across the Namakwa District to address the current housing backlogs. Figure 6-4 illustrates settlements in the core region where informal housing structures are present. It should be noted that several settlements in close proximity to the proposed development also exhibit a high number of informal structures, including Sanddrift, Port Nolloth, Steinkopf, Carolusberg, and Bergsig (Springbok settlement cluster).

6.2.3 Settlement and regional related infrastructure challenges

The region, particularly the settlements within it, currently faces several infrastructure challenges. Municipal incomes are inadequate to meet these needs, thus relying on government transfers, sector projects, or private sector investments. To understand the municipal realities in this region, all facets of municipal governance must be considered. This section will focus on infrastructure components; please also refer to Chapter 7 of the SEA (Atkinson et al., 2026) which includes additional socio-economic and municipal governance aspects.

6.2.3.1 Water and sanitation

Responsibility for water and sanitation planning and infrastructure management in the region lies with local municipalities. According to the 2022 census:

- 76.8% (26,070) of households in the Namakwa District Municipality have piped water within their homes

- 83.8% (28,442) have flush toilets connected to the sewer system
- Approximately 13.4% (4,534) still depend on pit latrines or the bucket system

These figures underscore persistent water and sanitation backlogs in certain settlements. Reliability of water supply remains a concern across the region as reflected in Table 6-3:

Table 6-3: Water reliability.

Municipality	Water Reliability
Khai-Ma	77%
Nama Khoi	52% (lowest)
Kamiesberg	62%
Richtersveld	64%

Source: (DBSA, 2024, p. 20).

The common water and sanitation challenges faced by municipalities include ageing infrastructure, insufficient capacity, a shortage of skilled personnel, a lack of Operations and Maintenance (O&M) plans, and financial constraints. The most recent Blue Drop report assessing the quality of municipal water systems reveals critically low scores across the region. The municipalities recorded the following results: Richtersveld at 21.94%, Khai-Ma at 15.19%, Nama Khoi at 36.61%, and Kamiesberg at just 8.02%. Scores below 31% are classified as being in a critical condition (Department Water and Sanitation, 2023, p. 22). Table 6-4 highlights the scores for individual towns within the Richtersveld Local Municipality, all of which are alarmingly low and show a downward trend compared to previous Blue Drop assessments.

Water and sanitation capacities act as critical limiting factors for settlements and must be improved before they can accommodate incoming and expanding populations, which are likely to result from major regional projects.

Table 6-4: Blue Drop scores - Richtersveld Local Municipality.

Performance Area	Port Nolloth/ Alexander Baai	Eksteensfontein	Khuboes	Lekkersing	Sanddrift
Blue Drop score 2023	23.0%	29.75%	10.90%	28.25%	10.09%
Blue Drop score 2014	47.0%	39.0%	43.0%	36.0%	28.0%
Blue Drop score 2012	35.0%	44.0%	29%	41.0%	42.0%

Source extracted from: (Department Water and Sanitation, 2023, p. 444)

Specific issues include high water debt and difficulty in collecting water rates in the Nama Khoi Local Municipality, deteriorating water infrastructure in Khai-Ma, and water scarcity exacerbated by developments in Richtersveld Local Municipality. Kamiesberg Local Municipality faces challenges with a dilapidated sewer network and billing inefficiencies. Annexure C lists the proposed water and sanitation projects for the region. The following challenges affect water and sanitation in the region (DBSA, 2024):

Nama Khoi Municipality – Water losses due to aging infrastructure limit supply. New housing developments are putting pressure on the sewer network requiring the upgrading of oxidation ponds.

Khai-Ma Municipality - The water infrastructure has deteriorated, with aging asbestos pipelines over 50 years old causing frequent bursts and maintenance issues. There is inadequate storage capacity in the water supply, which hampers sustainable service delivery. To address current problems the upgrading the bulk water reticulation, wastewater treatment facilities, and enhancing storage to a 48-hour norm is required.

Richtersveld Municipality – Settlements in this municipality faces water scarcity, which will be exacerbated by the proposed development of Boegoebaai Port and SEZ. Without significant intervention this development will put further strain on the already insufficient potable water supply, necessitating the installation of bulk and reticulation services, including water, sanitation, electricity, and roads. A study to investigate the alignment of a new water pipeline to Port Nolloth projected an additional 2000 households to be accommodated in this town (BVi Consulting Engineers, 2023). Proposals by the municipality to address this includes increasing water extraction and purification, as well as installing solar backup to mitigate the impact of power interruptions, such as load shedding (DBSA, 2024). In addition to meeting the domestic water needs of surrounding settlements, the proposed Boegoebaai Green Hydrogen infrastructure will necessitate the development of desalination facilities within the Special Economic Zone (SEZ). These plants will be essential to ensuring a reliable supply of high-purity water for the production of green hydrogen at scale.

Kamiesberg Municipality - The sewer network infrastructure of Kamiesberg is dilapidated and inadequate. This results in frequent breakdowns, leaks, and failures, necessitating new construction, refurbishment, and upgrades to meet the growing demand. The installation of prepaid water meters and the construction of large-scale sewage infrastructure to enhance capacity and ensure effective wastewater treatment are some of the interventions planned by the municipality (DBSA, 2024).

6.2.3.2 Road Infrastructure.

Roads play a crucial role in this sparsely populated and isolated region. The area features two national roads: the north-south N7 that connects Namibia and Cape Town, and the east-west N14 link providing access through Springbok to the eastern part of the Northern Cape and onto Gauteng (these roads fall under the South African National Roads Authority (SANRAL)). Currently, these roads are in good condition.

Figure 6-5: R382 road a) Steinkopf to Port Nolloth, b) Port Nolloth to Alexander Bay.

(Maritz, J., 2024b)

Near the proposed Boegoebaai site, the provincial access road (R382) branches off the N7 from Steinkopf (70 km north of Springbok) to Port Nolloth, covering approximately 90 km of bituminous surfaced road (Figure 6-5a). The route from Port Nolloth to Alexander Bay (R382) is also a bituminous surfaced road. Boegoebaai lies approximately 60 km north of Port Nolloth (Figure 6-5b).

This road will serve as a crucial access route to and from the proposed port and SEZ. These roads have been taken over by SANRAL (2024), which has recently appointed engineering firms to carry out condition and design assessments in preparation for planned standard maintenance activities on the R382. However, these planned maintenance projects do not consider the anticipated developments and likely increased usage at Boegoebaai. Annexure D outlines current priority road projects aimed at addressing the most pressing needs in the region.

Many gravel roads in the study area are in poor condition, limiting access to smaller settlements. Several municipal roads require substantial repairs to meet acceptable standards. Within these smaller settlements, internal gravel roads—often damaged by water—require paving, while existing tarred roads need rehabilitation due to water ingress and deterioration.

According to the **Rural Roads Asset Management System (RRAMS)**, a significant portion of surfaced roads are classified as being in poor condition. Addressing these issues will require a combination of new road construction, upgrades, refurbishments, and improved drainage systems to enhance safety, accessibility, air quality, and the overall user experience. Due to funding constraints, some municipalities rely on **Expanded Public Works Programme (EPWP)** grant funding to carry out essential repairs and maintenance (DBSA, 2024).

6.2.3.3 Electricity

The current electricity distribution network in the region is sparse, as historically it had to cater to a relatively small load (ESKOM, 2024b, p. 123). Eskom and local municipalities jointly distribute electricity to consumers, with local municipalities typically serving towns and Eskom managing distribution in townships and villages (DBSA, 2024). Without any significant development in the region, the energy demand forecast remains gradual. However, the mining sector has recently expanded in Khai-Ma, and there has also been a rise in mining activities near Springbok. Currently, many municipalities utilise electricity at capacity on their Notifiable Maximum Demand (NMD) (ESKOM, 2024a), often exceeding thresholds and incurring penalties from Eskom. Discussions with ESKOM have revealed that the supply into the Namakwa supply area is sufficient, with generation significantly exceeding demand in the area (Marais, 2024). Some upgrades to the existing power infrastructure and distribution within settlements are needed to support growth in demand and facilitate electrification for new developments. This situation, however, does not account for the considerable impact on demand from the proposed Port and SEZ development. The 2024 Transmission Development Plan (TDP) indicates that the current evacuation of power from the region is limited and can be described as a constrained transmission grid (ESKOM, 2024b).

6.2.3.4 Renewable Energy (RE)

The growing demand for energy in South Africa, along with the need to reduce greenhouse gas emissions and diversify the energy mix, has driven the country's gradual expansion of its renewable energy sector (Akinbami, et al., 2021). Since the promulgation of South Africa's long-term electricity infrastructure roadmap, the Integrated Resource Plan (Department of Energy, 2011), renewable energy has been integrated into the national energy mix. The Renewable Energy Independent Power Producer Programme (REIPPP) has enabled private sector participation in power generation, increasing the country's renewable energy capacity.

This region has exceptional potential for solar energy production. Photovoltaic (PV) panels are preferred over Concentrated Solar Power (CSP) technology, as CSP requires large amounts of water, which is scarce in the area. Wind energy resources are also promising, particularly along the coastal plain and in the interior mountains. While offshore wind power is technically feasible, it is less ideal due to the significant depth of the ocean floor along this coastline (Grobler, 2024).

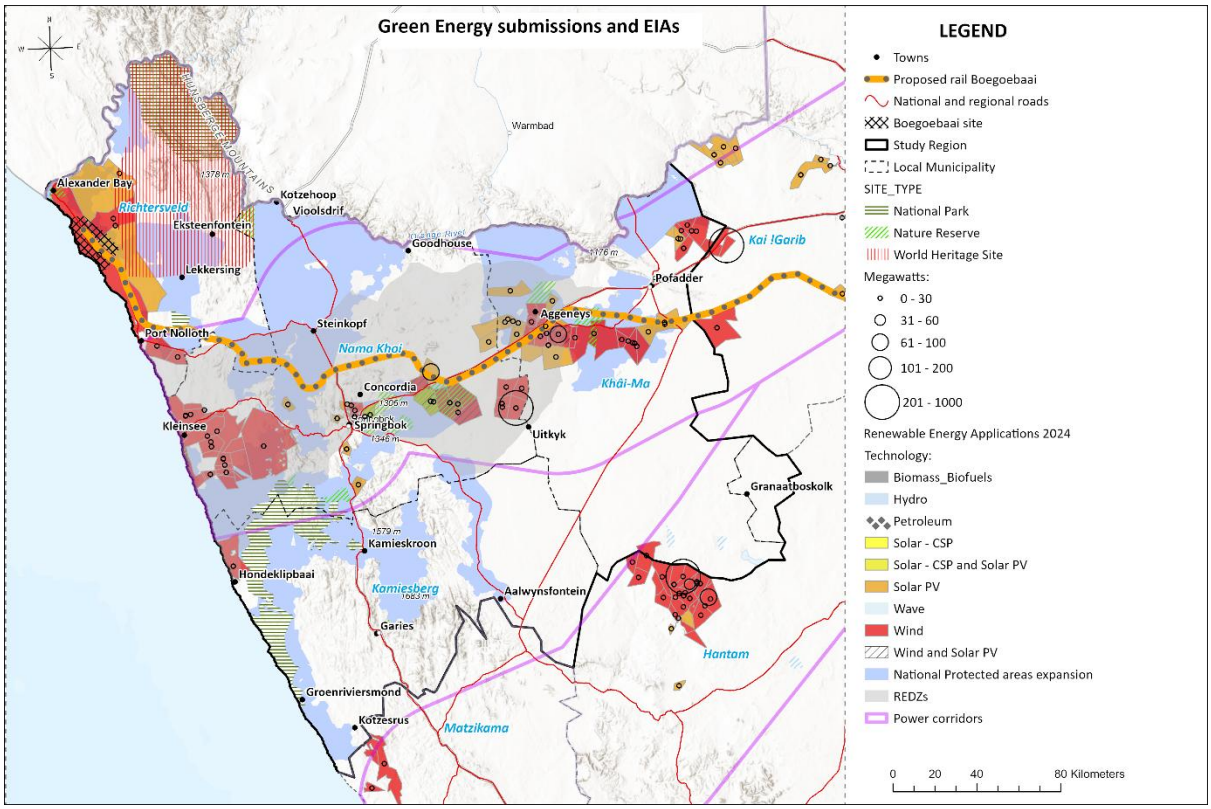


Figure 6-6: Green energy submission and EIAs

Source: (Department of Forestry, Fishing and Environment, 2024a)

The location of these renewable energy developments is often influenced by Renewable Energy Development Zones (REDZ) and strategic transmission corridors (see Figure 6-6). Within this region, the Northern Power corridor extends east-west, bordering Port Nolloth along the southern border of the Richtersveld Municipality. The RED Zone is within the power corridor and extends from the west coast towards Pofadder along the N17. A total of 171 projects or project applications are present within the power corridor in the region (Department of Forestry, Fishing and Environment, 2024a). Their status varies from approved projects that are operational to those that have been approved for construction or are in the process of evaluation. The wind and solar projects (applications) within the Richtersveld are located outside the power corridor and the RED Zone, indicating that some projects require additional transmission lines to connect to the grid or directly to sites such as the proposed Boegoebaai development.

6.2.3.5 Land and land ownership

The land ownership information reflected in Figure 6-7 combines the 2023 Richtersveld land audit and land ownership information from the Department of Rural Development and Land Reform. The Richtersveld Sida !Hub Communal Property Association (CPA) owns the land in the vicinity of Boegoebaai following a successful land claim. Alexkor currently uses the land for diamond exploration purposes in a pooling and sharing joint venture (PSJV) with the Richtersveld Mining Company (Department Transport, Safety and Liason, 2020, p. 33).

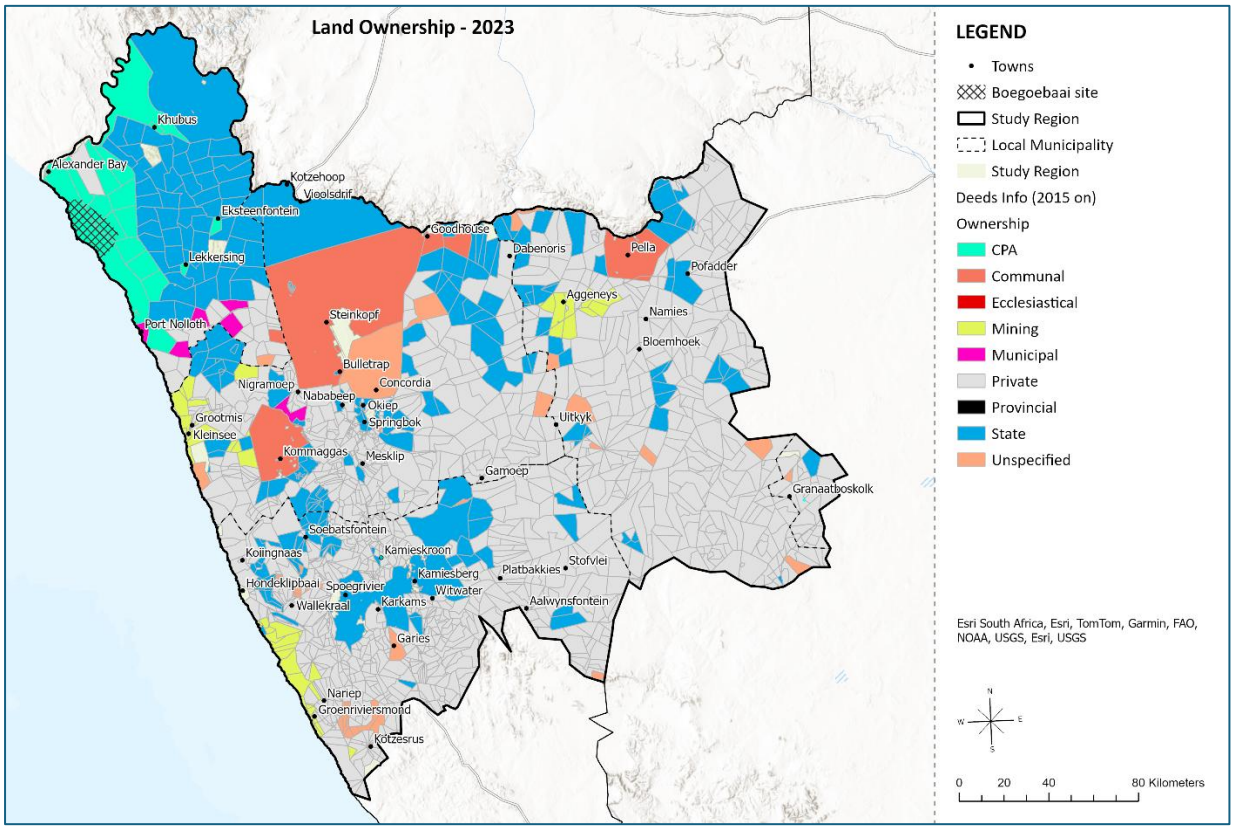


Figure 6-7: Land Ownership in region.

Source: (Maritz, 2023)

The southern part of the region is characterized by greater private land ownership, whereas the Richtersveld consists of approximately 28% CPA land, 58% state land, and 12% private land. The remaining land is designated for mining, communal, and municipal use. Any proposed development must align with the relevant municipal land use scheme, requiring agreements with landowners and developers. Given the various infrastructure projects that will require land, this aspect demands significant attention.

The CPA has approximately 2,630 beneficiaries across several towns, including Sanddrift, Kuboes, Lekkersing, Eksteensfontein, and Alexander Bay (Commision on Restitution of Land Rights, 2023). Internal disputes have emerged among members of the Richtersveld Communal Property Association (CPA) concerning management practices, financial expenditure, and the awarding of contracts. The matter was escalated to the National Department of Land Reform and Rural Development in 2024, but it remains unresolved (Fredericks, 2024).

Addressing communal land ownership is central, not peripheral, to the Boegoebaai port and SEZ: it affects legal permissibility, social licence, timing, risk and ultimately proceeding with the development. The proposed Boegoebaai Port and SEZ are located on land that forms part of a restituted communal landholding managed through the Richtersveld Communal Property Association (CPA), with land and associated rights held on behalf of the broader community. In this context, strategic support for the

development pathway is contingent on lawful, inclusive land governance processes that are consistent with applicable restitution outcomes and the protections afforded to informal and customary land rights, including the requirements of the Interim Protection of Informal Land Rights Act and related jurisprudence. Clear and transparent arrangements for land access, servitudes and decision-making in communal areas should therefore be treated as key enabling conditions for implementation, rather than assumptions, and should be advanced in parallel with other institutional and infrastructure readiness measures (also see section 7.5.4.3.3).

The town of Alexander Bay, previously a mining village for Alexcor, was consolidated into a new cadastral unit on which the township of Alexander Bay was incorporated into the Richtersveld Local Municipality in 2013. The Richtersveld local municipality has been reluctant to take over the responsibility of providing municipal services and managing engineering infrastructure over concerns related to aged infrastructure, poor road infrastructure and noncompliance of the electricity network to municipal standards (Public Enterprises, 2023).

With the anticipated development of new linear infrastructure corridors—such as electricity transmission lines, pipelines, and railways—careful planning, stakeholder engagement, procurement, and land use management will be essential for securing the necessary servitudes.

6.2.3.6 Rail infrastructure

There is no rail infrastructure in the region. The Sishen-Saldanha rail line runs along the southern border of Khai-Ma. All freight moving to and from the region is transported by road. Future rail lines will be considered when freight volumes increase and if a new port is developed at Boegoebaai.

6.2.3.7 Information and Communication technology

To assess ICT access in the region, current mobile phone coverage was examined. As shown in Figure 6-8, coverage is generally absent across most of the area but is more prevalent along national roads and in larger settlements. This indicates that certain technologies, such as EDGE, do not extend to the proposed port and SEZ site. While LTE is available at the site, its coverage may be limited. Currently, Vodacom 5G is not available in the region, and coverage from other providers, including MTN, TELKOM, and Cell C, is similarly restricted.

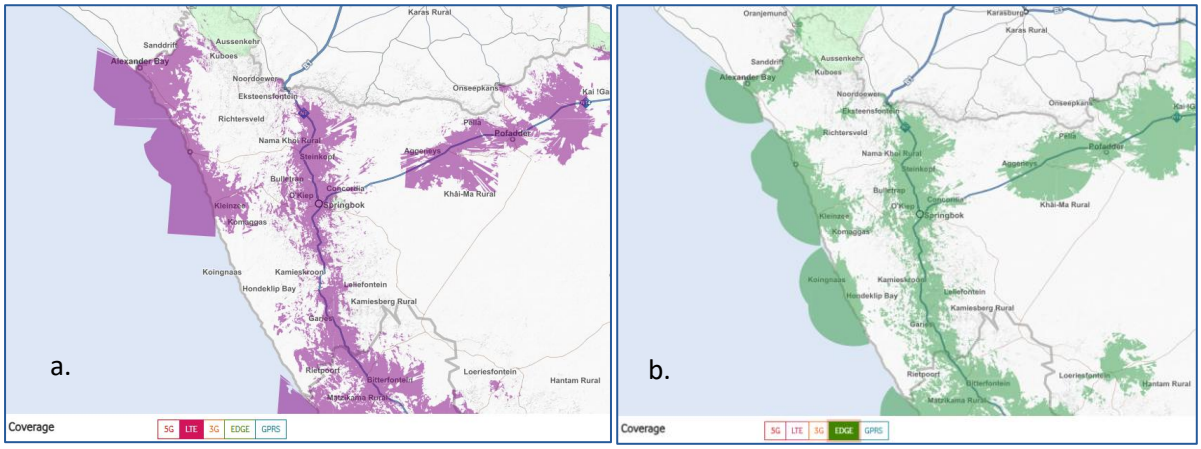


Figure 6-8: Vodacom coverage of LTE (a) and EDGE (b).

Source: (Vodacom, 2024. https://vccoverage.afrigis.co.za)

6.2.3.8 Gas Pipeline

The province does not have established gas or oil pipelines; however, the development of gas pipelines has been identified as an integral part of a future gas economy. Preliminary corridors were established during Operation Phakisa Offshore Oil and Gas in 2014. An SEA was conducted in 2017 to identify and pre-assess environmental sensitivities within suitable gas routing corridors, and, where necessary, to expand the identified electricity power corridors (Department of Environment, Forestry and Fisheries, 2019).

Any future green hydrogen pipeline from Boegoebaai will need to consider the identified corridors and the issues raised in the SEA. In May 2024, WESGRO, NCEDA, Namibia's Environmental Investment Fund, Gasunie, and Climate Fund Managers signed a memorandum of understanding (MoU) to promote the development of green hydrogen infrastructure. This initiative aims to connect South Africa's Western and Northern Cape regions with Namibia's Lüderitz/Windhoek region. As part of the agreement, a collaborative pre-feasibility study was launched to evaluate the viability of constructing a green hydrogen pipeline, forming the Western SADC Green Hydrogen Production Corridor. Completed by the end of 2024, the study analyzed technical, commercial, financial, socio-economic, and operational factors to determine the feasibility of establishing this green hydrogen corridor (WESGRO; NCEDA; GH2 Namibia; Climate Fund Managers; GASUNIE, 2024).

6.2.4 Regional development opportunities

In conducting the regional analysis, it is essential to account for major development initiatives that may influence the broader area. This approach provides a more balanced understanding of the baseline scenario. According to the **Northern Cape Office of the Premier** (Saul, 2024), several key anchor projects are emerging across the province, each with the potential to affect regional resources, elevate skill demands, and impact surrounding settlements.

Central to these developments is the **Northern Cape Industrial Corridor**, which spans from **Vaalharts** on the eastern border and follows the **N14 corridor** from east to west. **Figure 6-9** illustrates the geographic distribution of these initiatives. Notably, several large-scale projects are located outside the SEA region, including the **Kathu Industrial Park**, the **Kathu Housing Project**, and the **Upington Industrial Park**. Within the SEA region, significant investments include the **Namakwa Special Economic Zone (SEZ)** at **Aggeneys** and the **Namakwa Irrigation Scheme**.

Although the **Vioolsdrift Dam** is referenced as a potential development, its progress has stalled due to unresolved disputes between the South African and Namibian Governments, casting uncertainty over its future implementation (located on the lower Orange river is it intended to increase the yield of the Orange River System). In contrast, the **Namakwa SEZ** at Aggeneys is expected to have a substantial impact on regional dynamics, particularly in terms of resource demand, construction materials, workforce housing, and skills development. The SEZ is projected to generate approximately **6,000 direct and indirect jobs** during its initial phase (Modise, 2024).

If these projects are implemented concurrently with developments linked to the **Boegoebaai Port and SEZ**, they may compete for critical resources and skilled labour. This overlap could intensify pressure on regional infrastructure, including roads, water supply, electricity, and housing. Additionally, planning and municipal services may face significant strain if service expansion is not proactively anticipated and coordinated.

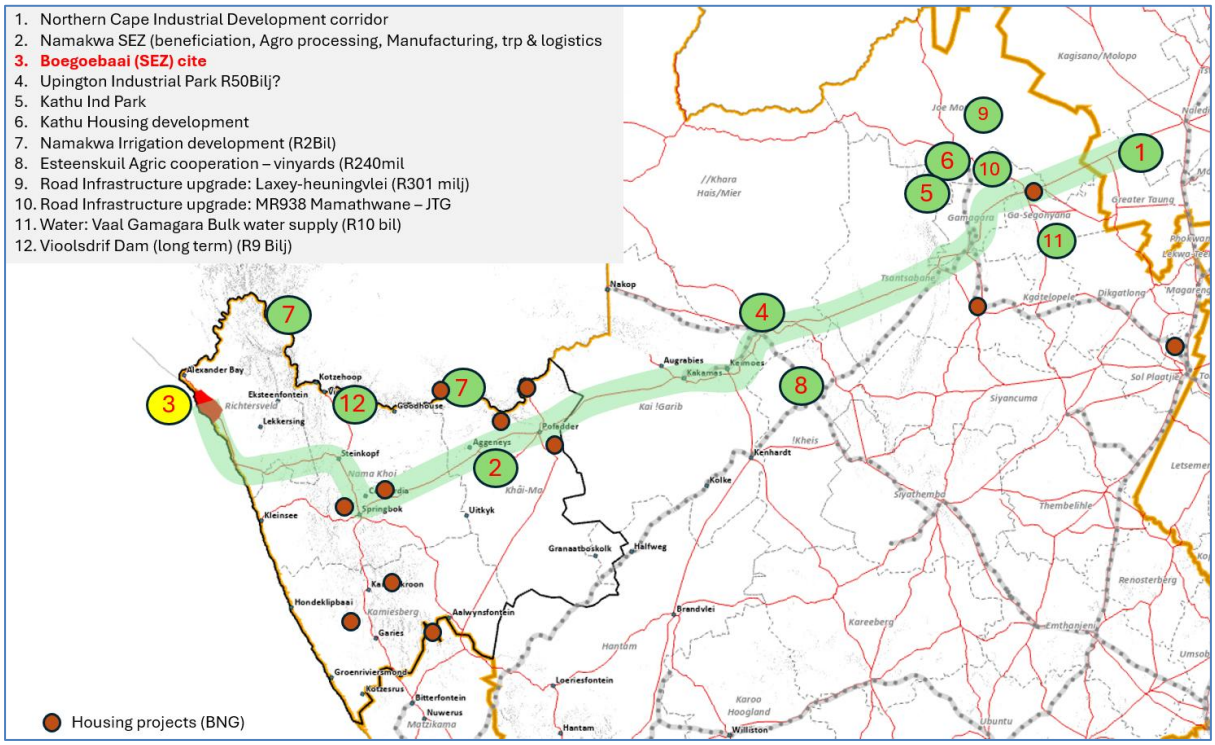


Figure 6-9: Large scale catalytic projects (Northern cape)

Source: (Saul, 2024)

Boegoebaai is proposed as a new deep-water port with associated rail and road infrastructure intended to connect the Northern Cape mining belt to international markets. The regional initiatives along the Northern Cape mining corridor are pertinent to the Boegoebaai development in that they contribute to the underlying demand and the infrastructural backbone that will support and further justify the establishment of both the port and the Special Economic Zone (SEZ). In turn, the port and SEZ are expected to function as the primary export outlet and as a catalyst for the expansion and upscaling of these corridor projects. Projects located outside the immediate study region will influence the settlements and communities in their respective areas, while simultaneously enhancing the overall financial viability of the proposed port. Within the study region, projects such as the Namakwa SEZ, the Namakwa irrigation development, and the Vioolsdrif Dam are anticipated to exert more pronounced effects on the Strategic Environmental Assessment (SEA) area. Settlements in close proximity to these projects, including Aggeneys, Goodhouse, Vioolsdrif and Noordoewer, are expected to experience increased social pressures and to bear certain infrastructure burdens. The specific sites earmarked for project implementation will, in addition, be subject to elevated environmental risks. Other settlements within the region, such as Steinkopf and the Springbok settlement cluster, are also likely to be affected through increased settlement pressures. At the same time, these settlements are expected to benefit from associated capital investments, particularly in the form of enhanced physical and service infrastructure.

6.3 POTENTIAL IMPACTS AND POSSIBLE MANAGEMENT

The development of the new port and SEZ along with its linked infrastructure will result in a myriad of impacts both locally and in the wider region. This section outlines the main planning and infrastructure related impacts likely to arise. In summary these relate to the following themes:

- Spatial development planning, land use management and governance
- Settlement development and service delivery implications, and
- Construction of large economic infrastructure projects.

6.3.1 *Spatial and Development Planning, land use management and governance*

The increased land use applications and infrastructure developments in the region will affect several towns and their municipal governments. The affected Municipalities, the Northern Cape Province, and the National Government need to be prepared to support and guide the Port, SEZ, critical infrastructure components and associated downstream developments.

The proposed development of a new Port with the adjacent SEZ and linked infrastructure elements such as renewable energy resource developments in the region, would require timeous and synchronised planning to ensure that the various phases of the proposed development align within the range of relevant medium-term spatial- and integrated planning instruments (Figure 6-10).

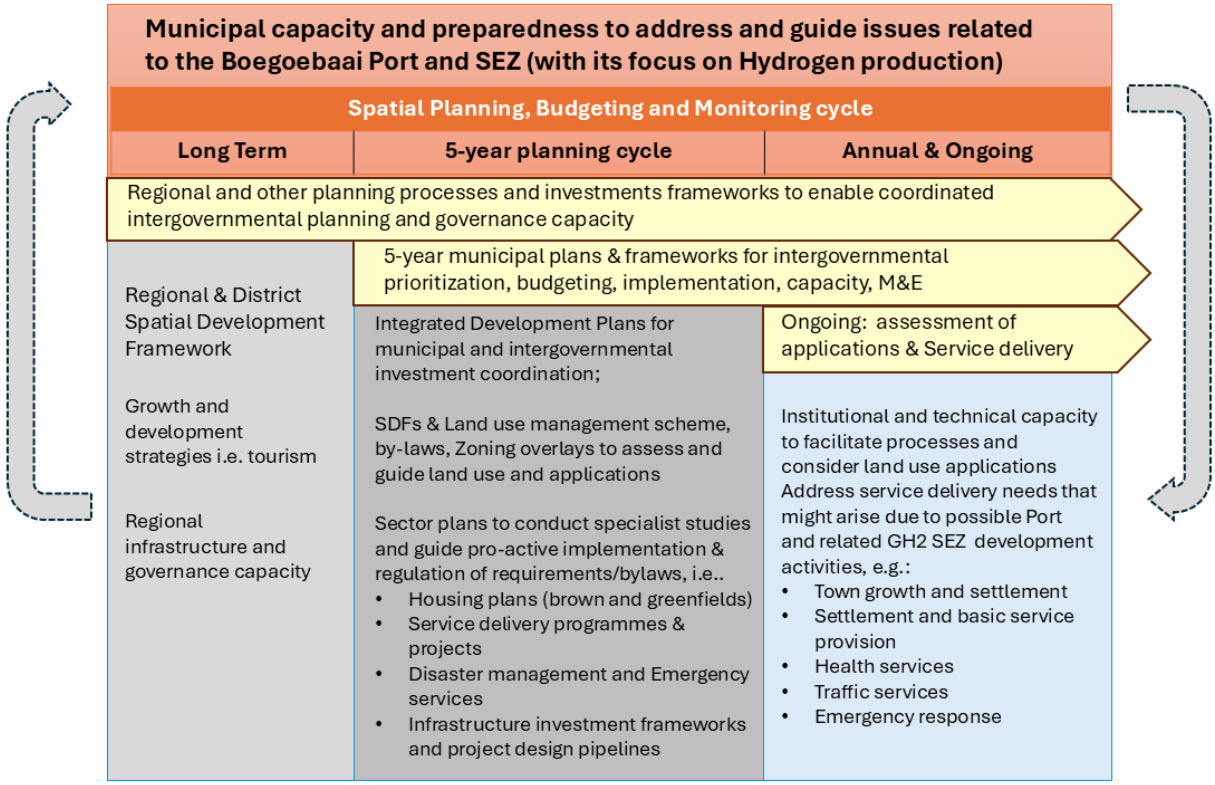


Figure 6-10: Municipal capacity and preparedness to address and guide issues related to the Boegoebaai Port and SEZ.

Source: (Van Hyussteen, et al., 2016, pp. 18-38), adjusted by author.

Spatial planning tools enable municipalities to consider land use applications and prepare for increased service demands from higher traffic, migration, and population growth in towns.

The proposed development of the port and SEZ is expected to positively influence municipal revenues in the region and contribute to the national treasury. However, accommodating these developments will require investments to manage the influx of people employed in various activities directly and indirectly linked to the projects. Given the already stressed settlement areas, investment in multiple infrastructure components will be essential. This investment should focus on fortifying settlements, particularly in the main municipality of Richtersveld, covering essentials such as adequate bulk water supply, sanitation, road systems, electricity, housing projects, and associated social services.

Due to the limited access routes to the port and SEZ, vital roads like the N14, N7, and R382 will need protection to manage increased traffic, primarily from heavy vehicles. Enhancing traffic safety and

mitigating road damage from overloading are pressing issues needing attention. The importance of emergency incident response will grow, not only due to local traffic but also from the movement and parking of heavy freight vehicles passing through towns, necessitating improved traffic management in areas like Springbok, Steinkopf, and Port Nolloth.

Development contributions concerning the infrastructure and service impacts must be evaluated. In certain instances, the organizations responsible for developing the port and SEZ could be liable for regional bulk infrastructure investments. Moreover, the anticipated ongoing land use and development applications associated with the port and SEZ scenarios for small and large hydrogen production will demand additional resources and administrative capacity to handle regulatory processes, straining local authorities further. It's crucial to note that while land use regulatory systems exist in the region, the capacity to effectively implement them daily is limited. Therefore, even minor adjustments to existing resource and land use patterns will create considerable challenges in regulatory processes as well as in environmental and spatial planning in the area.

6.3.1.1 Baseline scenario

As reflected in section 1.6, the region, comprising four local municipalities and the District Municipality, possesses the necessary planning instruments to manage land use and engage in strategic planning. However, the nature of growth and economic development (or decline in certain areas) has resulted in limited planning capacity. Significant planning decisions have been made through a District Municipal Planning Tribunal that convenes quarterly. The financial situation of these municipalities places them in a challenging position—staffing resources are scarce, and currently, no registered professional planners are employed within these municipalities (although two planners in Nama-Khoi Local and Namakwa District Municipalities are in the process of full registration). In the absence of any major development, the existing processes and planning mechanisms will persist. The transition of the town of Alexander Bay is an ongoing endeavour between Alexcor and the Richtersveld Local Municipality, hindered by a lack of municipal resources and the current state of infrastructure in the town. Additionally, 20.6% of households in Richtersveld are deemed indigent and require support, further straining municipal resources.

6.3.1.2 Small Green Hydrogen scenario

As the Port and SEZ developments begin, there will be numerous land use change applications related to the new projects. These include impacted settlements requiring housing, essential infrastructure like water pipelines and power lines, and the establishment of green energy installations. Addressing the significant traffic volumes on the N7, N14, and construction on the R382 will necessitate coordination with local municipalities on services, the development of construction site camps, traffic safety, and land arrangements. Since much of the Richtersveld consists of communal land, the Richtersveld Sida !Hub Communal Property Association will be a key stakeholder in certain spatial planning processes.

The diverse range of developments affecting land use will also require engagement with various authorities, including the Department of Environmental Affairs, the Department of Rural Development and Land Reform, the Department of Energy, the Department of Water Affairs, the Department of Mineral Resources, SANRAL, Transnet, ESKOM, the Department of Trade, Industry and Competition, and the Northern Cape Department of Cooperative Governance, Human Settlement, and Traditional Affairs for the Northern Cape Province.

In the built-up areas of the Richtersveld Municipality, initial planning suggests that towns like Port Nolloth and Alexander Bay will receive significant population increases. Several towns will face land use changes due to expansion, which will present substantial challenges. These rural municipalities are where governmental capacity constraints pose the greatest challenges. Processing land use applications within reasonable timeframes and enforcing and monitoring decisions may be difficult. Currently, a District Municipal Planning Tribunal oversees the planning process, but the anticipated rise in applications and related issues will necessitate enhancements to decision-making mechanisms.

One approach could involve the Namakwa District Municipality taking a more prominent role in regional planning support. Furthermore, the Northern Cape Province could leverage additional capacity to assist

municipalities with land use and development application processes. Over the next 5 to 10 years, a variety of developments are expected to impact the region, with several infrastructure projects occurring simultaneously. This period will see a notable increase in planning activities, requiring added support and capacity. However, some large infrastructure initiatives may not emerge until green hydrogen production and port utilization increase. For significant projects like railways, transmission lines, or pipelines, it is crucial for Provincial and National Government to play a pivotal facilitating role.

6.3.1.3 Large Green Hydrogen scenario

In this scenario, the production of green hydrogen is set to expand significantly. Municipal systems and processes will face considerably increased pressure. The increased scale of development activities is expected to generate a high volume of regulatory applications and service demands across all government levels. Specifically, the ongoing and cumulative rise in land use and development applications will impose a heavy burden on less-equipped municipalities. To sustain robust investment and development trends, it is essential to maintain the planning support mechanisms previously established in the Small Green Hydrogen scenario. Given the expected increase in regulatory applications, settlement expansion, infrastructure corridors and cumulative demands on municipal systems, a threshold-based approach should be adopted. Development approval processes should be sequenced so that large-scale land use applications and associated infrastructure decisions proceed only once minimum planning support capacity, updated land use management arrangements, municipal coordination mechanisms and land access protocols are demonstrably in place. In the absence of such enabling measures, planning pressure should be treated as a strategic constraint rather than only a manageable capacity risk.

This period is anticipated to witness a surge in green hydrogen production alongside higher exports from the port, particularly manganese. As a result, two key infrastructure projects will be necessary: building a rail line from Kenhardt to Boegoebaai and developing pipelines to convey green hydrogen to inland areas. These initiatives will affect municipalities concerning land use applications, servitudes, and support for construction camps. Furthermore, the expansion of green energy projects, particularly wind and solar, will be crucial to meet the increased size and power demands of electrolyser systems, impacting landowners where infrastructure intersects their property.

It is vital to consider the various settlements in the region. Over-investment in one or two towns could jeopardize smaller settlements, prompting residents to move toward the more prosperous ‘growth towns." Therefore, fostering a balanced investment strategy is important to ensure that developments in Boegoebaai and the port do not compromise the vitality of smaller communities. Municipalities and their planning functions must prioritize the preservation of Nama and traditional communities residing in more remote and smaller settlements.

6.3.2 Settlement development and service delivery implications

Within the study area[2] the Richtersveld Municipality is the focal point of a range of developments linked to the port and SEZ and as such, is the primary receiving area. The town of Springbok located at the heart of the study area serves as a Regional Development Anchor where the largest range of social facilities can be accessed. It is also the home of the Namakwa District Municipality. Other towns that provide a rural service centre role are Steinkopf and Port Nolloth. These are also the largest towns in the region housing the largest settlement populations (see Annexure A). Within Khai-Ma and Kamiesberg the largest towns are Pofadder and Garies respectively. The remainder of the region comprise mostly small and dispersed settlements. The towns that have exhibited the largest residential growth over the period 2015-2022 are Springbok, Alexander Bay, Vioolsdrift and Poffadder. In the past mining was a key driver of growth, benefitting towns of Aggeneys, Springbok, and Alexander Bay. Diamond mining, by the ailing state owned Alexcor, has been declining in the Richtersveld Municipality (Mail and Guardian, 2007), leading to a decline in employment opportunities and the local economy. Although the mining town of Alexander Bay is in the process of transfer to the Richtersveld Municipality, some aspects are delaying transfer. Considering both Port Nolloth and Alexander Bay have been identified as the key receiving towns, this has a number of implications including ensuring that these towns can accommodate settlement growth and can provide

[2] Richtersveld, Nama Khoi, Khai-Ma and Kamiesberg municipalities.

social services for a growing population (SRR, 2024). Currently, the town of Alexander Bay is in a deteriorated condition, with public buildings and streets in need of maintenance and repair (see Figure 6-11). This reflects the town's vulnerability and highlights the importance of pre-investment before significant population growth occurs as a result of construction activities and project implementation associated with the proposed port and SEZ.

Figure 6-11: Alexander Bay: condition of infrastructure: a) Abandoned buildings, b) Damaged hospital, c) Decaying streets, d) Rubble in streets.

Source: (Maritz, J., 2024b)

Most of the population residing in the region (89%) live in settlements and towns and according to the 2024 Partner-a-District diagnostic assessment, two in every five people in the Namakwa District live in poverty, further illustrating the current depressed nature of these settlements (DBSA, 2024). This high level of dependence also means that municipalities face increasing pressure for sustainable basic and social service delivery while being burdened with limited human and financial resources. As indicated in Table 6-4, the growth rate in this region varies from settlement to settlement; the overall growth rate is 2.4% per annum (Municipalities of SA, 2024). This still has implications that include a rising demand for housing, access to water, electricity, and sanitation, as well as local amenities (parks, sports and recreation), social services (health care, education, home affairs offices, etc.), and associated facilities.

Planning documents and strategies indicate that new settlement growth should be absorbed into existing settlements and should not lead to the creation of new ones (SRR, 2024) (Erioloba Consulting, 2024). The National Spatial Development Framework stipulates that settlement development should be decoupled from standalone developments such as mining (and industrial) developments – the housing and associated needs should be provided for in existing settlements (Department of Agriculture, Land Reform and Rural Development, and Department of Planning, Monitoring and Evaluation, 2021, p. 121). However, this requires that the most affected settlements be equipped to manage rapid growth when the port and

SEZ developments commence. Although some recent studies identify Port Nolloth and Alexander Bay as the primary affected settlements (SRR, 2024), the settlement choices of new residents moving into the region cannot be entirely anticipated or quantified. A local example of this can be seen in Aggeneys (home of the Namakwa SEZ), where some employees commute from Okiep, Springbok, and other surrounding towns in the Nama Khoi municipality—covering an average distance of approximately 112 km (Thomas, 2024)((Bezuidenhout, 2024)). The anticipated development of the Boegoebaai SEZ may lead to comparable settlement patterns, potentially expanding residential areas beyond Port Nolloth and Alexander Bay. It is essential to acknowledge the settlement-related challenges of towns likely to be recipients of large numbers of new residents. The increase in expected employees linked to the range of new infrastructure will place pressure on the primary receiving settlements (Alexander Bay and Port Nolloth). This would also mean significant land and land-use-related applications and approvals need to be processed timely. Furthermore, this will increase pressure on the current planning governance of the affected municipalities, especially Richtersveld. Table 6-5 provides a set of likely settlement implications for the predefined scenarios. It must be noted that it cannot be assumed that all employees will be accompanied by their families (households) seeking household accommodation.

Table 6-5: Estimated direct settlement implications linked to Port and SEZ (Green Hydrogen Production scenarios)

Scenario	Skills required (From high skills to labourers)[3]	Migration pressures	Town based settlement implications	On-site settlement implications
Baseline Scenario	The Namakwa SEZ would draw in an estimated 6000 direct and indirect jobs (Modise, 2024). Some green energy projects (wind and solar) currently proposed (and not linked to the Boegoebaai SEZ) could both develop - and draw in - skills, especially during construction.	There is limited economic growth in the region with the exception of mining development north of Springbok and at Aggeneys (incl. the Namakwa SEZ), which would generate some jobs in those areas. Otherwise, jobs are limited, and local job creation should be prioritised. In-migration associated with mining can be expected to increase the pressure on housing and service delivery. Main areas of expected (even though limited) growth are settlements around Springbok, Aggeneys and Pofadder.	Rental accommodation is likely to increase in towns such as Springbok (confirmed by interview with local realtor), although the Springbok area has limited new housing developments and growth in property market is slow. Pofadder and Aggeneys are the other towns in which settlement pressure is likely (Bezuidenhout, 2024).	Settlements are likely to be affect by other large-scale developments and projects occurring in the region, notably the Namakwa SEZ and mining developments near Springbok. The towns that are likely to be affected are Aggeneys, Pofadder and the Springbok cluster. Construction camps could be erected at towns or at the infrastructure project sites, with added pressure in nearby towns for housing.
Small Hydrogen Production Scenario	This period represents the start of numerous infrastructure projects, with most resources and additional skills required during the construction phases (2027/8). It is estimated that approximately 4198 to 5638 new direct employees will enter the Richtersveld Local Municipality (estimates calculated in Table 5). Many would not necessarily be permanent residents in the area, due to the temporary nature of the work and limited settlement options. Some water and electricity network infrastructure projects are also likely to commence at this stage to support port and SEZ development. This will	Whilst pressure for job creation would result in preference provided to local residents, some of the skills required might need to be sourced from outside the region, which would likely result in substantial in-migration. Incoming migrants will predominantly be accommodated in existing towns (e.g. Alexander Bay and Port Nolloth). Some infrastructure projects could have temporary construction site camps that relocate as construction proceeds in different areas. In-migration will likely affect the economy of local towns through an increased demand for goods and services. There is also the likelihood of more people entering the region seeking work, which is not necessarily	It is anticipated that the towns impacted would mainly be Alexander Bay and Port Nolloth (SRR, 2024). An increase in the need for rental accommodation could lead to pressure to develop additional housing and/or a rise in property values. Port Nolloth as the larger centre is likely to be the preferred choice for property development. Alexander Bay could be considered to accommodate labourers and be the site for much of the Port and SEZ construction housing. In both these towns' water, electricity and sanitation infrastructure will require expansion (to cater for additional housing and construction demand) and upgrading (to improve existing,	Staff settlement on-site (at the port or at large scale infrastructure developments) is likely to be limited and predominantly comprise of port operators and security personnel. The majority of staff are likely to reside at towns such as Port Nolloth and Alexander Bay. For some infrastructure development projects temporary on-site construction camps could be preferred (example solar and wind projects) during the construction phase (Olivier, 2024). After construction – operational staff are likely to stay at towns such as Port Nolloth or Alexander Bay. Some staff could choose to locate in other settlements such as Springbok, but this may be limited due to distance and/or limited housing and services available (Bezuidenhout, 2024)

[3] The skill number are based on examples / ratios from similar projects. The detail design of the project would detail the numbers more accurately.

Scenario	Skills required (From high skills to labourers)[3]	Migration pressures	Town based settlement implications	On-site settlement implications
	also require skills, but employment is likely to be temporary.	directly associated with the port and SEZ. Generally, immigration is likely to place pressure on towns, especially when that results in informal settlement growth.	often under-capacity or ageing systems).	(Thomas, 2024).
Big Hydrogen production scenario	The extent of infrastructure development is associated with the growth in green energy in the region, including the expansion of desalination, electrolyser and related green hydrogen production components. Once the port and SEZ is established, the expansion of hydrogen related production components will likely generate fewer direct employment opportunities. Job creation could be influenced by an increase in the number of solar and wind projects taking place in the region, as well as the expansion of the gas pipeline and rail construction.	Given that most of the initial construction in the Richtersveld will be completed in the Small Hydrogen Scenario, the projects associated with the expansion to the Big Hydrogen Scenario would likely affect the wider region. Infrastructure projects such as rail and pipelines could cause inmigration into the region.	Growth in green hydrogen production and associated in migration could possibly sustain the housing market in Port Nolloth and Alexander Bay. Alexander Bay is likely to continue to be the preferred location for lower-income housing. Growth in the SEZ industrial park could stimulate higher-income property development in the region, especially in Port Nolloth.	Most of the original developments at the port and SEZ are complete in this scenario, so initial settlement pressure is significantly reduced (Schreiner, et al., 2024). In the Big Hydrogen scenario port operators and security personnel are likely to stay on site. During the construction of associated infrastructure, on-site construction camps could also be established within the broader region. After construction, operational staff will likely reside in towns such as Port Nolloth or Alexander Bay. Some staff could relocate to other settlements such as Springbok, but this is likely to be limited due to distance or a lack of housing availability.

Source: Compiled by Authors.

6.3.2.1 Baseline Scenario

Settlement development in this scenario is limited, with only a few large projects in the region (see Figure 6-9). The Namakwa SEZ will significantly draw in skills and impact the towns of Aggeneys and Poffader. The likelihood of the construction of the Vioolsdrift Dam remains uncertain at this stage; however, it could be a significant project that may affect settlements along the N7, extending from Springbok to Vioolsdrift, including Steinkopf. The Namakwa irrigation project could also influence settlements along the Orange River. With minimal construction and operational job opportunities for the residents of Richtersveldt, incremental growth is expected to continue in towns like Port Nolloth and Alexander Bay. The pressure on local service infrastructure is substantial enough to warrant necessary upgrades in the local municipality. Water supply, waste, and sanitation services require urgent improvements to address the demands of the current population (see Section 6.2.3). Although Alexander Bay will be transferred to the Richtersveld Municipality, without ongoing financial support from Alexcor or the state (e.g., Department of Cooperative Governance and Traditional Affairs), the future of Alexander Bay remains uncertain. Currently, the town exhibits signs of decay and neglect, significantly impacted by the decline of the local mining economy.

Springbok, as the regional anchor town, could experience growth due to the preference of residents working in the region to reside here, given the range of services it provides, which is also stimulated by the evolving mining sector nearby. Other projects that could impact several towns include the revitalisation of Port Nolloth harbour, ongoing regional development of solar and wind plants, the construction of a regional hospital (in Springbok), and the revitalisation of the regional airport (in Springbok).

6.3.2.2 Small Hydrogen Production Scenario

During this phase, numerous initiatives begin to affect land development, including the Port and SEZ industrial estate, alongside green hydrogen-related projects, wind and solar parks, road improvements, and the construction of transmission lines and pipelines. These developments will attract a skilled workforce requiring accommodation: limited onsite lodging at the SEZ and Port necessitates that housing primarily be established in Alexander Bay and Port Nolloth. The skill level of these workers is likely to determine the type of accommodation sought, considering that construction activities are only temporary, with fewer workers seeking property ownership. Those with high skill levels will most likely reside in Port Nolloth or even as far as Springbok, commuting regularly to the area. If Alexander Bay Airport were to be reopened and upgraded to accommodate scheduled commercial flights, it could additionally support the mobility of higher-skilled workers through the implementation of a fly-in fly-out operational model. Accommodation will also be required for less skilled workers, divided between the towns of Port Nolloth and Alexander Bay, given the preference to live as close to the new developments as possible. Additional low-skilled accommodation could be available in construction site camps unless developers prefer to house their workers in the nearest settlement; in this case, towns must ensure they can accommodate these residents.

Past South African experiences, such as in-migration related to developments in various mining towns, echo international boomtown phenomena where large developments draw significant numbers of people, which can strain municipal resources. This could lead to potential informal settlement development and increased service demand, particularly during construction phases. An increase in the demand for (higher end) rental accommodation for specialists associated with multiple infrastructure projects and/or support services could result in rising property values, which may subsequently encourage the conversion of existing housing stock to rental accommodation and guest houses. Uncertainty at the onset of the first phase (Small Green Hydrogen Scenario) could create opportunities for ‘quick wins’ in the property market through estate developments, land use changes, or even illegal sub-letting. Additionally, an increase in land and other resources needed to accommodate township expansion and possible informal settlement upgrades, alongside timely provision of social and basic services, as well as upgrading bulk services capacity (especially regarding water availability and landfill sites), can be anticipated.

A significant proportion of highly skilled professionals and skilled workers would likely commute and primarily utilise rental accommodation. Many local employees and individuals who may have migrated to the area in the ‘hope’ of finding work will probably lack alternative options. The economies of the towns (especially Port Nolloth and Alexander Bay) are likely to experience growth during this period, and the

footprint of urban expansion (both private sector and government) will likely escalate, along with an expected increase in the indigent population associated with migration. This scenario may mean local economies and enterprises utilise the opportunities for growth and diversification, or municipalities may face an unsustainable burden in service delivery and finance. High pressure on municipal service delivery infrastructure is anticipated in this scenario and will persist until financial support is rendered to the municipality for upgrades to water, electricity, and waste infrastructure. It is improbable that these municipalities, particularly the Richtersveld, will be able to finance these expenditures in the absence of additional guaranteed fiscal commitments. Developments, such as the movement of large numbers of heavy vehicles transporting mining products to the port, traversing through the centre of Port Nolloth, could present a point of conflict and possibly raise traffic safety concerns. This could also detract from the perception of Port Nolloth as a coastal tourism destination.

6.3.2.3 Big Hydrogen Production scenario

At this point of the development, port facilities and regional transport networks will be fully operational and attracting substantial public and private sector investment. During this phase it is estimated that once the rail line is operational, the number of heavy vehicles to the Port will decrease, easing the strain on the R382. Once the additional pipelines become operational this will further decrease road-based heavy vehicle transport lessening the need to accommodate drivers staying over.

During this phase the pressure brought about by the construction activities of several simultaneous projects has declined and the region will settle into the operational phases for several infrastructure items. It is the operational employees that are more likely to establish in the region along with their households also requiring a variety of commercial and residential services for daily living. The growth in the development of green energy (wind and solar parks) continues to ensure it meets the energy needs of growing electrolyzer and desalination infrastructure at the SEZ. It is unclear to what extent the residential growth will spill over into towns such as Kuboes and Lekkersing as these towns are small, have limited social facilities and are less accessible by poorly maintained gravel roads. Steinkopf could also grow as a settlement, located on the N7 main road and in closer proximity to Springbok (the regional anchor town). It could potentially offer a place to settle for those seeking more affordable property. The growth in the SEZ and the synchronous economic growth in Port Nolloth, will have implications for informal settlement growth, service demand and associated unintended consequences. This could further impact the demand for water and sanitation, landfill facilities, social facilities, etc. This will place pressure on the Richtersveld Municipality for the delivery of services.

Unless a concerted effort is made to accommodate and train the local population in light of the opportunities offered by the Port and SEZ (particularly the operational phase), some households in towns will likely still be dependent on government grants, and local economies will continue to be largely dependent on the government service sector. This is likely to have spatial implications in the expansion of informal settlements. Skills development within the local population should be undertaken within the areas of solar and wind energy, which are likely to expand during this scenario within the region.

6.3.3 Construction of large economic infrastructure projects

Several large infrastructure projects, some occurring simultaneously, will affect the region. These will include roads, new rail lines, new pipelines, and possibly new electricity transmission lines. Although their construction and composition differ, they are, with the exception of green energy plant projects, all significant linear transport corridors that will require detailed planning, alongside the necessary applications and approvals. They will involve substantial construction over several years, extend across extensive sections of land requiring servitudes, and necessitate large construction teams with a range of skills for implementation. The following section briefly outlines the primary economic infrastructure projects.

6.3.3.1 Pressure on critical national and provincial access roads

A critical component for the port and SEZ development is the access roads to the greenfield site of the proposed project. As these roads will provide the necessary access for various purposes, including freight, construction, and employee access, their condition, design, and function become critical considerations. A recent study has indicated that the Northern Cape, including this region, has significant potential for growth in mining activities (such as zinc, nickel, lead, copper, and cobalt) enhanced by the realisation of Boegoebaai Port. Of particular interest are the roads connecting the Northern Cape mining belt and the proposed Port.

Current access to the site occurs predominantly via national roads, namely the N14, N7, and the R382 (see Figure 6-12). National Road N7, which runs from Cape Town to Namibia, and N14, from Springbok to Upington in the Northern Cape, fall under the South African National Roads Authority (SANRAL). The following table lists the key network between the Northern Cape mines (and large provincial economic centres) and Boegoebaai.

Table 6-6: Road network between Northen Cape Mines and Boegoebaai.

ROUTE (ROAD) - COMMENTS	LENGTH
National Roads (all Class 1 surfaced)	
Sishen to Upington (N14)	230km
Upington to Springbok (N14)	370km
Steinkopf to Port Nolloth (N7)	50km
Provincial Roads (all surfaced)	
Steinkopf to Port Nolloth (R382) – Provincial trunk road	90km
Port Nolloth to Boegoebaai (R382) – Provincial road	60km
Total Main Road network length	**800km**

Source: adapted from (TM consulting and Nelutha, 2019a)

Based largely on the manganese commodity demand and the locality of the Northern Cape Mines, it is envisaged that the first phase of the development of the will result in the transportation of mining ore via vehicular truck transport along the N14/N7/R382 corridor. Currently the Sishen to Saldanha Bay OREX Line, is the only heavy haul rail line that passes through the province. However, this line will eventually reach capacity and require major upgrading. Should the volume of iron ore to Saldanha decline due to possible mine closures, it could open the OREX line to accommodate more manganese for export. Most Northern Cape mining exports currently run through the Sishen to Saldanha line. Manganese is also exported from the Northern Cape via the Port Elizabeth and Ngqura line. Ideally, a large amount of manganese could be exported through the proposed Boegoebaai Port instead. Due to the large weight and long distances required to transport the manganese ore from the mines mentioned, heavy haul carriers are needed. The availability of the new Boegoebaai Port will result in the growth of heavy vehicle volumes, predominantly moving on the N14, N7 and R382.

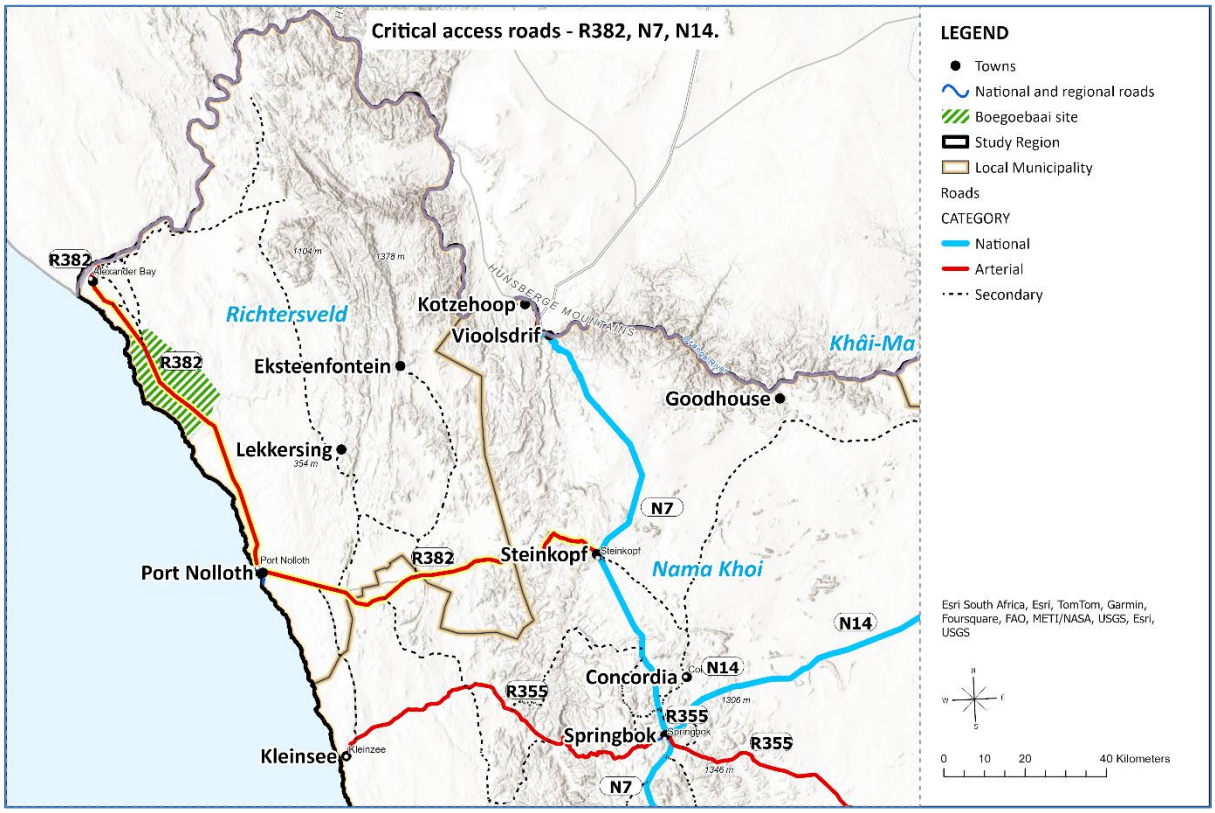


Figure 6-12: Critical current access to proposed Greenfields site.

Source: (Maritz, 2025a)

Information sourced from the South African National Roads Agency indicates that the 2024 road freight volumes on the N14, N7, and R382 were low. The R382 (TR82/1) between Steinkopf (N7) and Port Nolloth (90km), including the Anenous Mountain pass, was initially constructed in 1979 to bituminous standards, over 40 years ago, with likely routine and periodic (re-seal) maintenance interventions. Indications suggest that the road has reached its residual design life and is due for improvements. According to SANRAL, two road engineering consultants were appointed in 2024 to conduct a Road Safety Audit to evaluate the existing road layout and assess the detailed designs for the periodic maintenance of route R382 sections. Whilst fully laden trucks from the mines will be descending the pass to the coast, the return trip to the mines may necessitate the construction of climbing lanes on the steep sections of Anenous Pass. Road R382 between Port Nolloth and Alexander Bay was built in 1991 to class 3 specifications and has reached its design life, requiring rehabilitation and/or reconstruction, alongside Phase 1A of the Port development. It is envisaged that Boegoebaai Port will initially attract freight from the Northern Cape Mines exceeding a total of 6Mtpa (See Table 6-7); and it is assumed that mining commodities will be transported by road from the Northern Cape Mines during the first five years after the Port becomes operational. The road-based commodities transported to the Port are expected to reach 10MTPA by 2035 (TM consulting and Nelutha, 2019a).

Table 6-7: Commodity demand - Boegoebaai (High Case demand)

Cargo Type - Commodity	Volume (Mtpa[4]) 2030[5]	Volume (Mtpa) 2035	Volume (Mtpa) 2050
Dry bulk – iron Ore	0	0	0
Dry Bulk – Manganese	4.5	6.0	9.0
Break bulk – Lead/Zinc	0.7	0.7	0.7
Break bulk – Magnetite	0.3	0.3	0.3
Break bulk - Ilmenite	0.1	0.1	0.5
Liquid bulk – Diesel	1.3	1.37	1.7
Containers – agriculture products	0.15	0.21	0.42
Containers – Salt	0.03	0.03	0.03
Containers – general Cargo	0.75	0.90	1.28
Total	**7.83**	**9.61**	**13.93**

Source: adapted from: (TM consulting and Nelutha, 2019a, p. 18)

This would translate into a large number of heavy vehicles that would significantly impact these roads. During the first year of Port operation, it is estimated that 561 heavy vehicles will visit the Port per day. This is projected to increase to 829 by 2050 (TM consulting and Nelutha, 2019a). This only reflects heavy vehicle traffic on these roads; however, as a shared infrastructure resource, the road also serves tourists, commuters, and other travellers moving between Alexander Bay, Boegoebaai, Port Nolloth, Steinkopf, Springbok, and beyond.

Baseline scenario

When examining the development trends indicated in planning documents (such as SDFs and IDPs), apart from the Namakwa SEZ and possibly the Vioolsdrift Dam, the region shows few significant growth prospects. Should the decline in diamond mining in Alexander Bay persist, unemployment is likely to increase, especially in the Richtersveld Municipality, prompting some skilled workers to look for opportunities in areas like the growing mining sector near Springbok and the Namakwa SEZ's development at Aggeneys. Standard road maintenance will continue, depending on available funding. SANRAL has included the R382 in their network and has hired consultants for ongoing maintenance. This will facilitate access to Port Nolloth from Steinkopf and help those needing to reach the northern areas of Richtersveld. The other roads face challenges due to a lack of funding. Maintaining gravel roads to smaller settlements is already difficult and is expected to remain problematic, given the continued funding shortfalls for regular upkeep. This issue is particularly pronounced in the Richtersveld Municipality, as shown in Figure 6-13, which deters the use of ordinary vehicles on certain gravel roads.

[4] Mtpa = million tons per annum
[5] Ordinally calculated with start date of 2019, adjusted to 2030 and 2035 respectively assuming assumptions remain unchanged.

Figure 6-13: Gravel Road (to Eskteenfontein) where drivers are advised by road alert signs to use a bakkie or 4x4 vehicle.

Source: (Maritz, J., 2024a)

Small Green Hydrogen Scenario

At this stage, construction of the Port will begin, followed by the SEZ, anticipated within the first five to six years (refer to Table 6-13). This development will result in the transportation of equipment, materials, and resources along existing routes, especially the N14, N7, and the R382, which connect major centers and areas beyond the region. The N14 and N7 are established national routes in South Africa, facilitating business, trade, and tourism. Furthermore, the N7 is a vital access point to Namibia. The influx of large construction vehicles may elevate the risk of accidents, material spillage, congestion, and potentially lead to the deterioration of road infrastructure if not managed properly. Within the region, traffic will flow past communities like Springbok and Steinkopf, necessitating solutions for traffic safety. The R382 currently traverses the main streets of Port Nolloth, and the rising heavy vehicle traffic is expected to disrupt the town's tranquil environment, generating noise and air pollution. Accordingly, traffic management and road safety measures along the R382 in Port Nolloth must be prioritized. Beyond the region, the N7 and N14 will facilitate the transport of equipment from Cape Town and along the mining corridor towards Kimberley, and some construction materials may need to be sourced from outside the area.

While green hydrogen production is recognized as the main driver behind Port development, it is important to emphasize that the Port will also function as a significant export hub for regional mining commodities, particularly manganese. Once operational and ready for exports, mining commodities are expected to become key export products. Initially, trucking will be the only method of transporting these commodities. Only after reaching a transport volume exceeding 10 Mtpa will a rail line be established to support the movement of goods to the Port. Projected demand for mining commodities and related truck traffic to the port are shown in Table 6-8. (a single standard heavy bulk mining truck has a payload of 34 tons)

In addition to the initial pressure caused by the various construction activities, the substantial volume of heavy vehicles and other traffic travelling to and from the port will impact road safety (particularly through settlements) and will also lead to increased noise and air pollution. The rise in traffic will also require the implementation of enhanced emergency response and traffic management measures. Due to the significant rise in loads resulting from the high volume of truck traffic, it is recommended that construction of the rail line be initiated earlier than originally planned in the preliminary studies.

Table 6-8: Projected commodity truck traffic to port[6]

Projected commodity mix Truck traffic	Year 0 (2025) - 2030	Year 20 (2045) - 2050
Commodity Demand (Mtpa)	7 128 000	10 528 000
Trucks per annum	204945	302703
Trucks per month	17079	25225
Trucks per day	561	829
Trucks per hour	28	41

Source: adapted from: (TM consulting and Nelutha, 2019a, p. 23)

The R382 linking Steinkopf and Alexander Bay is becoming an increasingly vital shared asset. It is crucial not only for the regional mines but also as the sole road access to the SEZ for hydrogen and related products. Furthermore, it acts as an important access route for employees at the port and SEZ.

Recognizing that the R382 was not designed for high traffic volumes,and considering the significant anticipated heavy vehicle traffic from the mining areas along the N14 (Table 6-9), major construction or reconstruction will be required. The segment of R382 (TR8201) from Steinkopf, past the Anenous mountain pass to Port Nolloth, is in poor condition. Reports by TM Consulting (2019a) indicate that only 18% of the road is in good shape, while the remaining 82% is rated from warning to severe condition and needs strengthening. Rehabilitation or reconstruction of the R382 is critical, requiring a pavement design life of 25 years and an ES30 pavement capable of supporting 30 million E80s over that period. SANRAL has acknowledged the necessity for maintenance along the R382. Given that the road likely has reached its design life and needs rehabilitation, it is unlikely that the existing structure can withstand the anticipated loading due to commodity demands transported to Boegoebaai port by road. Additionally, higher pavement design specifications and specific climbing lanes will be necessary on the Anenous mountain pass between Steinkopf and Port Nolloth.

During this phase, significant deterioration of key national roads (N7 and N14) is not expected as port and SEZ construction begins; however, to manage the increasing and sustained freight flow beyond 2030, greater attention must be directed towards upgrading and rehabilitating these routes. Considering the lengthy timeline required to design and construct the R382 (approximately six years) (TM consulting and Nelutha, 2019a), this may disrupt other construction and trade activities. Demand for water and construction materials will surge during the roadwork period. Some materials will be sourced from outside the region while others locally investigating and approving local borrow pits will be necessary. Temporary site camps for construction workers and stockpiled materials are likely to be established on approved sites (see example in Figure 6-14). This process should involve engaging with landowners and the municipality to secure land and service access. At this point, identifying and permitting approved gravel pits will commence.

Construction-related mitigation for road and corridor development should specify minimum requirements. These include approved traffic management plans; pre-construction road condition surveys; agreements on road damage repair and maintenance responsibility; approved borrow pit and material sourcing arrangements; and municipal service protection measures where construction activity interfaces with local roads, settlements and services. Construction camps associated with road or corridor works should be located on disturbed or low-sensitivity land where practicable, avoid sensitive receptors, provide compliant water supply, sanitation, waste management and stormwater controls, and include clear rehabilitation and closure requirements

[6] Table adjusted from original, start dates.

Figure 6-14: Road site adjacent to road.

Source: (Maritz, J., 2024a)

Other roads: In the Richtersveld, smaller municipal gravel roads connecting communities like Lekkersing, Eksteensfontein, and Khubus could be affected by development. Furthermore, roads accessing the Nama Khoi municipality's Kleinsee and Grootmis are also included. These roads are located within 150 km of the site, and aside from the centres of Alexander Bay, Steinkopf, and Port Nolloth, they serve settlements likely to attract incoming workers looking for accommodation.

Big Green Hydrogen Scenario

At this point in hydrogen production, roughly six to seven years in, the Port is fully operational, and the output of green hydrogen is steadily increasing. Key construction phases for several elements are completed, including the finished R382, which improves access to Port Nolloth, the Port and SEZ, and Alexander Bay. As green hydrogen production and port usage rise, the roads will continue to support increasing volumes of heavy vehicles, particularly on the N14, N7, and R382. Close monitoring and regular maintenance are crucial, with most tasks being outsourced. This phase will also include the construction of a railway line aimed at providing an alternative route for transporting mining commodities from the central and eastern parts of the province, depending on funding availability. If the railway project faces delays, the road network will still handle substantial freight movement to the port. The anticipated rise in traffic will lead to a reduction in the lifespan of these roads, requiring more frequent maintenance, which will necessitate dedicated funding. Monitoring the road system holds great importance due to the high traffic on certain routes. SANRAL is well-prepared to oversee its road network and coordinate necessary maintenance and construction efforts.

6.3.3.2 Proposed rail line

A major consideration for Boegoebaai is its role as a crucial export Port for the Northern Cape Province. The mining sector stands to gain significantly from the development of this new Port. Initially, freight transportation to and from the Port will rely on road transport; however, as freight and export volumes increase, a railway system will be required to alleviate pressure on the roads (TM Consulting and Nelutha, 2019b). The Port's proximity compared to other national ports, along with lower transport costs, would also enhance exports of commodities from various locations within the Northern Cape. In particular, the Aggeneys Mine, located 340 km by road from the Port, will benefit from Boegoebaai's implementation. This mine, part of the Namakwa SEZ, primarily extracts copper, manganese, lead, and zinc. The proposed

railway will connect to the existing rail infrastructure, broadening transport options from other parts of the Province, especially the eastern region. This rail line will link to the Sishen to Saldanha line, facilitating service to mines in that corridor, including Orien Minerals and Kumba Sishen Mine, both found in the Copperton area and focused on zinc and copper production. In the interim, the key transport routes to connect Boegoebaai Port with the Groblershoop area (eastern extent) will be the existing main roads (N14, N7, and R363).

The principal challenges for the rail line's design occur near the Anenous Pass, west of Steinkopf, and along the connection from Steinkopf to the N14. Alignment issues arise from factors such as the terrain, the current road layout, and the mineral types present in the area.

The mining industry is responsible for nearly two-thirds of the commodities traded in the Northern Cape, with around 25 million tons of general freight transported from the region. Once Boegoebaai Port is operational, it is expected to handle a larger volume of commodities, allowing mining operations to increase their capacity. The planned railway will primarily transport manganese from the Hotazel and Aggeneys mines. Until the rail line is functional, heavy vehicles will be the main mode of transport to Boegoebaai Port. Construction of the rail line (based on pre-studies) is also contingent on road freight volumes surpassing 10 MTPA. Until that threshold is reached, the rail line is unlikely to be built.

Careful planning of the alignment, servitude designation, and rail line construction will significantly impact communities along the route and the development landscape in areas adjacent to the corridor. Although the region is sparsely populated, it could influence land development, town expansion, and sustainable regional and community growth.

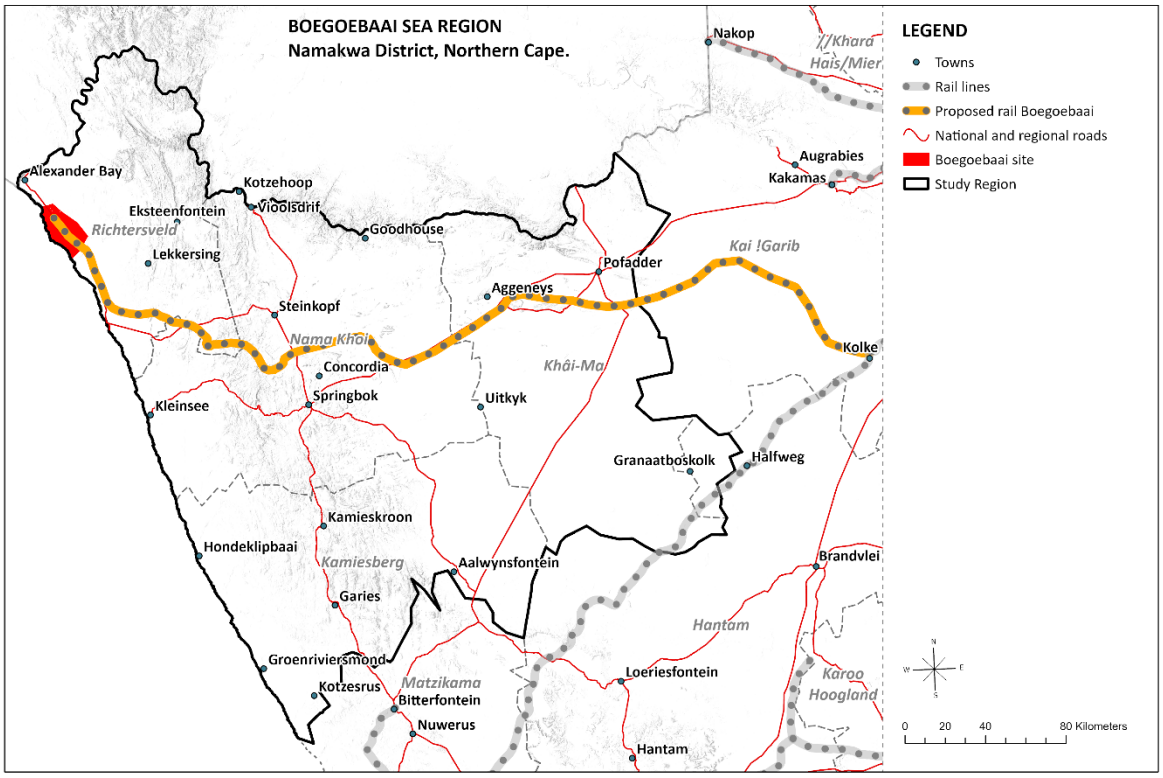


Figure 6-15: Proposed rail line from Kenhardt to Boegoebaai.

Source: (Maritz, 2024c)

Baseline scenario

Due to the lack of development at Boegoebaai, manganese, along with other mining commodities, is mainly transported by rail to Gqeberha, Saldanha Bay, and by road and rail to Durban. In the near future, these operations might also be merged and shifted to the Port of Ngqura. Additionally, the Port of Lüderitz

in Namibia has increased its capacity and is exporting manganese through the Trans-Oranje Corridor. Likewise, other commodities will keep utilizing the ports of Saldanha, Cape Town, and Gqeberha for their import and export needs.

Small Green Hydrogen Scenario

The construction of the Port and the initiation of green hydrogen production are expected to take place around 2028. Once the Port is operational, mining firms will use the new facility to export manganese and other minerals. As discussed in Section 6.3.3.1 about roads, the export of goods, mainly from the mining sector, will primarily rely on road transport until the volume reaches 10 Mtpa. Given the substantial expense of building a rail line, it is improbable that such a line will be developed until this export volume is either met or surpassed.

Big Green Hydrogen Scenario

Typically, a new standard-gauge railway line is justified only when freight traffic volumes exceed 10 Mtpa. Previous studies have predicted this level of traffic may occur by around 2035 (TM consulting and Nelutha, 2019b). To prepare for achieving these freight volumes, essential planning and design studies would have been conducted during the latter part of the Small Green Hydrogen Scenario. The rail line's construction period is anticipated to last 4 to 5 years, excluding planning, design, and tender phases. It is planned to extend approximately 500 km, routing from Boegoebaai Port towards Anenous Pass. The preferred route will intersect the N7 and cross the N14 towards the Sishen to Saldanha railway line (see Figure 6-15). Three bridges are necessary for road-to-rail intersections, along with an additional seven river bridges, all designed with a proposed width of 6 m. The proposal includes four tunnels, with the cut and fill estimated at about 100 to 120 million m^3. At least four crossing loops will be essential for the Boegoebaai Railway, with stations proposed at Aggeneys, Steinkopf, Port Nolloth, and Boegoebaai. The alignment of the proposed rail has been influenced by the existing layout and classifications of surrounding road networks, aiming to minimize road and rail intersections by aligning close to roads for easier maintenance. The main roads considered include R382, N7, and N14. The proximity of various mines in the Northern Cape Province is a significant factor in the rail's design, as it is intended to connect with these mines. Additionally, the existing Sishen to Saldanha rail layout influences the railway's alignment (TM consulting and Nelutha, 2019b).

A land acquisition study is necessary to investigate areas adjacent to the proposed rail alignment. Specialized facilities for storage and maintenance will be required. The maintenance facility at the port will feature a storage yard, cleaning area, inspection zone, and locomotive shop. Empty wagons and trains will be stored in depots for cleaning or servicing, thus, adequate water and power supply from relevant service providers will be essential. A voltage of 50 kV AC overhead catenary is proposed instead of the conventional 25 kV to support heavier loads and increase the distance between transformers. The projected financial costs for the rail line represent a primary risk, estimated to total around ZAR 16 billion.

Other significant risks include:

- The presence of traffic near the rail (on R382, and sections of the N7 and N14)
- Eskom’s capacity to meet energy demands from the rail implementation
- Surrounding ground conditions
- Risks related to environmental authorizations
- Property acquisition and servitude establishment.
- Project cost – affordability.

Constructing a rail line can be intrusive, necessitating land clearance, excavation to create a level surface, soil stabilization to prevent erosion, establishment of a subgrade layer, building the track bed with ballast, and laying cement ties and rails. The width for a single-track measures 6 m, as depicted in Figure 6-16.

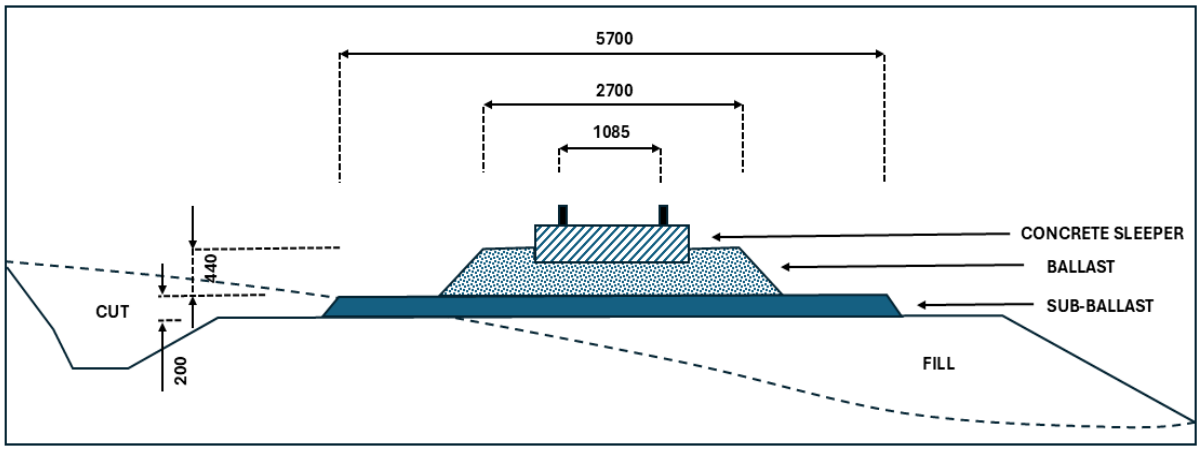


Figure 6-16: Rail Lines structure - cross-section.

Source: adapted from (TM consulting and Nelutha, 2019b).

Land ownership control

There is a clear preference and legal expectation that a Special Economic Zone (SEZ) node should be established on land that the applicant either owns or controls. The South African SEZ legal and regulatory framework requires that the applicant demonstrate ownership or control of the land proposed for designation as a SEZ. If the land is not already owned by the applicant, a clear strategy for acquisition or control must be provided as part of the application process. This is important to ensure that the SEZ entity can effectively manage, develop, and operate the zone without domain-related disputes or uncertainties.

The number of individuals engaged in rail line construction can differ significantly based on factors such as project length, complexity, location, and the degree of technology and automation employed. Typically, constructing a rail line necessitates a varied team of workers with diverse skills, resulting in a total workforce that may range from several hundred to thousands throughout the project's duration. Beyond engineering and technical expertise, a substantial portion of the workforce consists of construction labourers. Many general labourers participate in essential physical tasks, such as land clearing, excavation, grading, and building embankments, often involving hundreds of workers. Additionally, there are specialized teams tasked with placing ballast, installing ties or sleepers, and laying rails, which can range from dozens to hundreds, depending on the project's speed and scale. Furthermore, dozens of heavy equipment operators are also required. In remote locations, labourers are usually housed in construction or field camps.

6.3.3.3 Proposed pipeline corridor

Pipeline development is not a standalone infrastructure project for Boegoebaai; it is part of a broader vision to establish multiple hydrogen hubs along the west coast, including Lüderitz (Namibia), Boegoebaai, and Saldanha Bay. This initiative forms the backbone of the larger hydrogen economy. Initially, the hubs will be developed, and subsequently, they will be interconnected via pipelines. For the pipeline infrastructure to be sustainable, a large hydrogen system must be developed that relies on multiple hubs producing at scale, rather than a single hub. The pipeline is envisioned as a regional and transnational infrastructure that will serve as a system aggregator.

In 2019, a Strategic Environmental Assessment (SEA) detailing a phased strategy for developing a natural gas pipeline network in South Africa was undertaken (Department of Environment, Forestry and Fisheries, 2019). While the Boegoebaai SEA primarily focuses on a hydrogen pipeline, the significant findings (challenges and considerations) from the 2019 SEA offer a solid foundation for considerations relevant to green hydrogen pipeline development. The 2019 SEA clearly states that the construction of any pipeline, whether for natural gas or green hydrogen, will inevitably disrupt people's lives and livelihoods if built near existing or planned communities.

The anticipated disruptions include land use management issues that may render certain land uses unfeasible, as well as complications in tenure management due to the involvement of multiple landowners and municipal authorities. There is also a risk of resettlement and displacement, particularly if the pipeline route extends through densely populated or sensitive regions, which may lead to restrictions on future land development, adversely affecting local economies and service delivery.

To address these challenges, the 2019 SEA cites several actions that can be considered during the planning of pipeline developments. From the perspective of spatial and land use management, it is crucial to locate the pipeline away from densely populated rural settlements and communally owned land. Additionally, negotiations with affected landowners should occur to minimize disruptions and reach amicable compromises. It's acknowledged that pipeline routing must be carried out with the clear intention of minimizing potential displacements and avoiding conflicts with future township development plans (Department of Environment, Forestry and Fisheries, 2019). A hydrogen pipeline would generally fall under hazardous-chemical and pressure-equipment infrastructure, with approvals channelled through the relevant energy, environmental, and safety authorities, and its technical design directed by international or local hydrogen codes and standards. From a safety perspective, hydrogen pipelines are presently regulated under the Occupational Health and Safety Act and its associated regulations, including those relating to Hazardous Chemical Substances, Pressure Equipment, Construction, Explosives, and Major Hazard Installations.

Resettlement and relocation are a last resort, and the chances of this happening should be minimised. However, if relocation is unavoidable, efforts should be made to limit the number of affected individuals, prioritizing routing along existing transmission corridors as a mitigation strategy (Department of Environment, Forestry and Fisheries, 2019).

Moreover, the impacts of pipeline development on property values must be managed carefully, ensuring a transparent and equitable compensation process for any impacted property owners (Department of Environment, Forestry and Fisheries, 2019).

The 2019 SEA also emphasizes the potential effects of pipeline development on communities, advocating for continuous access to public services, roads, and emergency facilities for local communities during the construction phase to mitigate impacts (Department of Environment, Forestry and Fisheries, 2019).

The SEA highlights that disaster preparedness and emergency responses are essential components of pipeline development, recommending thorough risk assessments to mitigate risks of rupture, fire, or leakage. It is advised that pipelines built in “high risk” areas, such as those near communities, include designs aimed at leaking rather than rupturing to prevent catastrophic failures that could harm individuals (Department of Environment, Forestry and Fisheries, 2019).

All these findings should be incorporated into the hydrogen pipeline development in Boegoebaai along the north-to-south corridors (as mentioned in Operation Phakisa, see Figure 6-17) and the west-to-east corridor from Boegoebaai to Prieska (as outlined schematically in the Northern Cape Green Hydrogen Masterplan, Figure 6-18).

A prefeasibility study conducted in 2024 by WESGRO, NCEDA, Namibia’s Environmental Investment Fund, Gasunie, and Climate Fund Managers (2024) indicates that potential environmental impacts can be managed through appropriate mitigation measures, making it feasible to construct a pipeline close to public infrastructure. From a technical standpoint, constructing a predominantly underground pipeline appears feasible, with a 36-inch diameter being the most practical. However, it must be acknowledged that hydrogen and its related land use and planning requirements are currently unclear. A key issue is that hydrogen installations are classified as Major Hazard Installations, necessitating safety distances when planning and implementing such infrastructure. Currently, regulations or guidelines for these installations are insufficient.

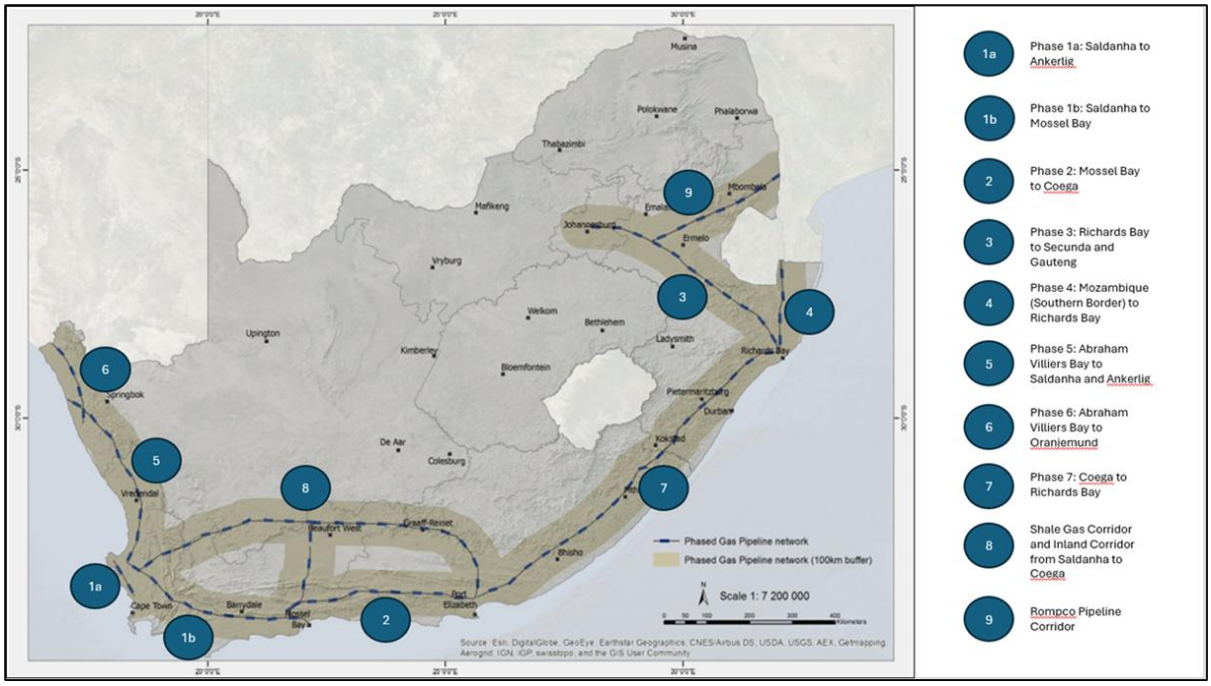


Figure 6-17: Operation Phakisa Phased Corridors including the north-to-south pipeline corridor.

Source: (Department of Environment, Forestry and Fisheries, 2019, p. 10)

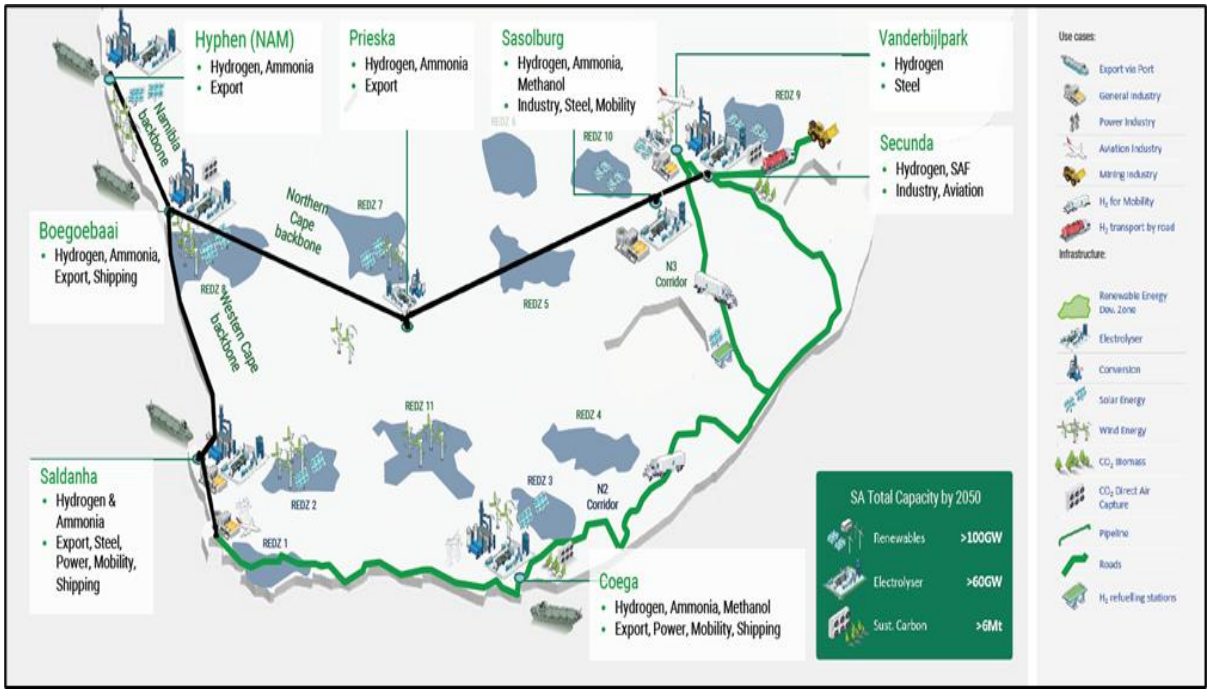


Figure 6-18: Northern Cape Green Hydrogen Masterplan with the envisioned north-south as well as east-to-west green hydrogen pipeline corridors

Source: (NCEDA, 2023)

Pipeline construction is a massive undertaking that requires careful planning and coordination across various sectors. The establishment of construction camps to house workers is crucial for efficiency,

ensuring that key personnel such as welders, inspectors, and medical staff are readily available on-site. In addition to human resources, infrastructure support is essential, local authorities may need to approve and provide services such as water supply, waste management, sewage treatment, and even access to borrow pits for materials. These logistical elements ensure a smooth construction process while minimizing environmental impact. The right-of-way for the pipeline itself, typically spanning 30 to 50 meters (see example Figure 6-19), must be prepared to allow sufficient space for installation, equipment movement, and safety considerations. This path must be carefully planned, considering terrain, existing infrastructure, and environmental factors. It's an intricate process that involves numerous stakeholders, from government departments to private contractors.

Given the length, scale and cumulative implications of linear infrastructure, pipeline routing, right-of-way establishment and construction camp planning should explicitly consider land rights, servitude width, biodiversity fragmentation, heritage sensitivity, road crossings, rehabilitation obligations, worker accommodation, and the capacity of local authorities to support temporary service demands. Minimum requirements for construction camps and servitude processes should therefore be defined in the management guidelines and reflected in project-specific EIAs.

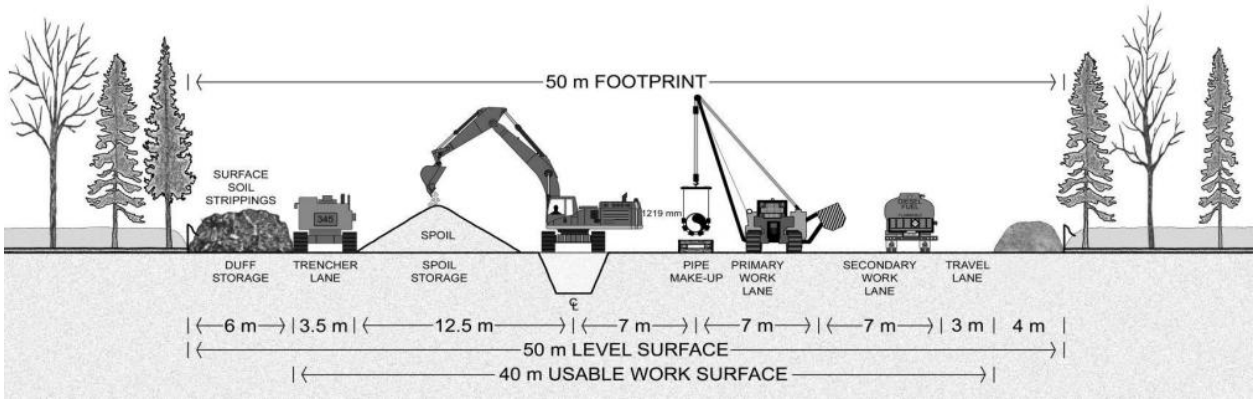


Figure 6-19: Example diagram of pipeline Right of Way and Workspace.

Source: (Ephraim, 2017, p. 7)

Baseline Scenario

The envisioned baseline scenario assumes that the transition to a green hydrogen economy could still progress albeit without Boegoebaai as a contributing hydrogen hub. Other hydrogen developments could still occur under this scenario including the development of the Luderitz and Saldanha hydrogen hubs. The development of a cross-national pipeline could still proceed connecting the Luderitz and Saldanha hubs. It is unclear at this stage what the effect will be on the overall feasibility of developing this pipeline should Boegoebaai not feature in the planning. It could however significantly affect the proposed east-west pipeline which would depend on Boegoebaai hydrogen production.

Although the 2019 Strategic Environmental Assessment (SEA) (Department of Environment, Forestry and Fisheries, 2019) for gas pipeline corridors recognizes the potential for expanding natural gas infrastructure in South Africa, it does not explicitly address the potential for green hydrogen. Nevertheless, the insights and structure provided by the gas SEA that could have potentially been leveraged to inform green hydrogen development, can be explored in the hydrogen scenarios.

Small Green Hydrogen Scenario

In contrast to the baseline scenario, the small green hydrogen scenario marks significant progress toward establishing green hydrogen pipeline infrastructure. Pipeline infrastructure is not a standalone development, but it forms part of a cross-national pipeline connecting the Luderitz–, Boegoebaai- and Saldanha Hydrogen hubs. It also positions the Boegoebaai Port and SEZ as a central hub for hydrogen production and distribution in the Northern Cape. The insights from the 2019 SEA provide a foundational framework for decision-makers to consider vital aspects of a potential green hydrogen pipeline development.

A key infrastructure initiative at this scenario involves the development of a dedicated green hydrogen pipeline along the north-to-south corridor, potentially using the framework established by phases 5 and 6 of Operation Phakisa within the 2019 SEA. This pipeline will connect Boegoebaai and adjacent renewable energy hubs with industrial centers along the West Coast extending to Saldanha and north into Namibia to Luderitz. Moreover, feasibility studies for the proposed west-to-east green hydrogen corridor, as envisioned in the Northern Cape Green Hydrogen masterplan, are set to begin, linking Boegoebaai to the Prieska Power Reserve Project and beyond (eventually leading to Gauteng). This process includes Environmental Impact Assessments (EIAs) to evaluate the ecological costs of the pipeline's development, alongside the acquisition of the essential land and rights-of-way.

The small green hydrogen scenario envisions the acquisition of land rights to facilitate the dedicated green hydrogen pipeline along the north-to-south route. This could potentially benefit from using the existing planning framework established in the 2019 gas pipeline SEA.

This is projected to develop between 2026 and 2035, initially focusing on establishing an electrolysis capacity of 5 GW, bolstered by 10 GW of renewable energy generation.

This small green hydrogen scenario presents economic opportunities by engaging local labour, especially during the construction of pipelines. Some challenges that could affect the construction of the pipelines include a potential shortage of skilled labour, challenges related to land rights (due to appeals and related issues), and environmental considerations regarding pipeline routing.

Strategic environmental management strategies are the proposed mechanisms to mitigate risks linked to biodiversity loss, water resource impacts, and land-use conflicts.

A prefeasibility study conducted in 2024 by WESGRO, NCEDA, Namibia's Environmental Investment Fund, Gasunie, and Climate Fund Managers (2024) identifies two potential routing options (Figure 6-20) for the proposed hydrogen pipeline:

- Scenario 1: This route follows the Namibian coastline, remaining close to previously designated production plots. Its proximity to the ocean facilitates access to seawater, a key resource for desalination.

- Scenario 2: This inland route positions the pipeline centrally between existing production plots and potential new development areas east of Lüderitz. While desalinated water could be supplied via a dedicated pipeline alongside the hydrogen pipeline, further investigation is required to assess feasibility.

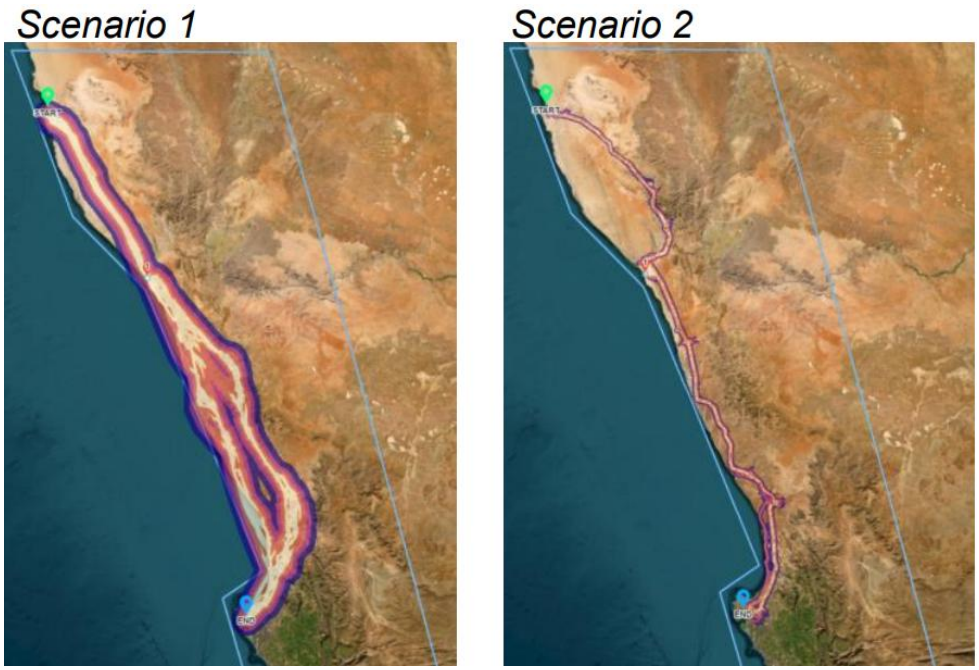


Figure 6-20: Possible pipeline route options.

Source: (WESGRO; NCEDA; GH2 Namibia; Climate Fund Managers; GASUNIE, 2024, p. 25)

Big Green Hydrogen Scenario

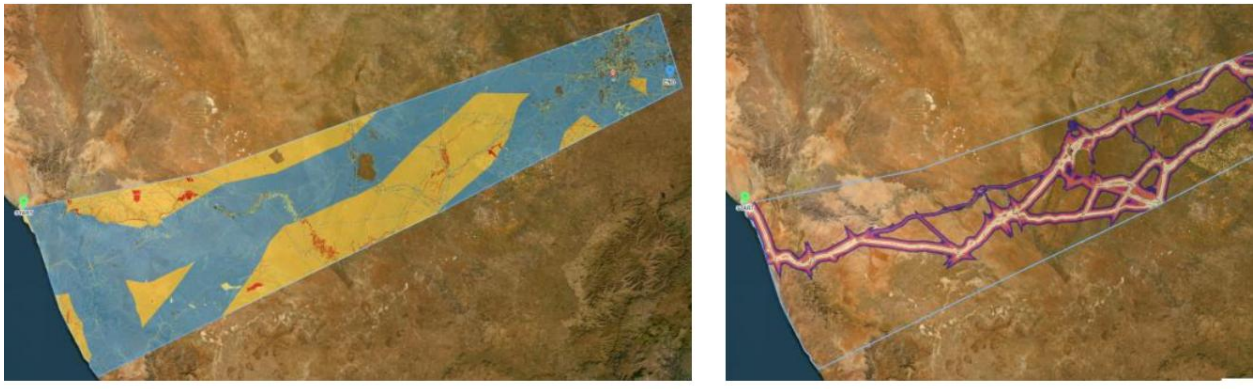
The big green hydrogen scenario envisions the expansion of green energy transmission pipeline network, adding the proposed west-to-east green hydrogen pipeline detailed in the Northern Cape Green Hydrogen Masterplan. This pipeline connects Boegoebaai to the Prieska Power Reserve and beyond to Gauteng, facilitating the direct transmission of green hydrogen to crucial domestic industrial centres, while the north-to-south corridor established in the previous scenario, links Boegoebaai to international markets, including a cross-border pipeline to Namibia.

The big green hydrogen scenario anticipates a fully operational green hydrogen production facility at Boegoebaai by 2050. This scenario envisions increasing electrolysis capacity to 40 GW, bolstered by 80 GW of renewable energy facilities. It envisions significant growth for the Boegoebaai Port and SEZ, with added infrastructure to support the large-scale export of green hydrogen and its derivatives like green ammonia, methanol, and e-kerosene.

The socio-economic advantages of the big green hydrogen scenario include substantial job creation during both the construction and operational phases of dedicated green hydrogen pipelines and associated infrastructure, such as desalination plants and renewable energy facilities.

This scenario could also present a number of environmental and social challenges. These challenges stem from the large-scale construction activities involved, which could impact sensitive ecological regions, including wetlands and critical biodiversity zones. It could also impact nearby settlements in the region (especially during construction). The Gas Pipeline Corridors SEA did not extent along an east-west route, which means that the east-west pipeline will require its own set of environmental assessments.

A prefeasibility study conducted in 2024 by WESGRO, NCEDA, Namibia's Environmental Investment Fund, Gasunie, and Climate Fund Managers considered the likely west-east routing. Key considerations guiding the routing include protected areas, existing land use such as urban areas, and existing infrastructure. These factors create varying levels of spatial resistance: areas alongside gazetted corridors and existing infrastructure are marked in blue, areas depicted in orange indicate lower spatial resistance, while areas marked in red signify high spatial resistance. It is preferable and recommended to route the pipeline within the gazetted corridors and bundle it with existing infrastructure (see Figure 6-21).



Resistance map (blue: corridor, orange light sensitive) Possible routings

Figure 6-21: Possible west-east pipeline routing.

Source: (WESGRO; NCEDA; GH2 Namibia; Climate Fund Managers; GASUNIE, 2024, p. 33)

6.3.3.4 Green Energy Projects

The production of green hydrogen relies heavily on green energy, particularly solar and wind power. The Northern Cape Province is well-positioned, possessing substantial land suitable for both energy sources. Various projects for developing wind and solar farms can be identified in the SEA region (see Figure 6-6, Section 6.2.3.4). The table below outlines the quantity of green energy necessary for hydrogen production as outlined in the Boegoebaai scenarios, beginning at 5GW and increasing to 40GW. To put this in

perspective - South Africa's total domestic electricity generation capacity from all sources in 2024 was 58,09 GW (Africa24, 2024).

Table 6-9: Green Hydrogen production estimations per Scenario

Aspect	Unit	Small Green Hydrogen Scenario	Big Green Hydrogen Scenario	Note/ assumptions
Electrolizer capacity	GW	5	40	Aim of Northern Cape GH Master Plan
RE capacity total	GW	10	80	1 Mt/yr of H2 needs 10 GW electrolyser, that is powered by 20 GW
RE capacity - solar	***GW***	***6***	***48***	**60 % solar : 40 % wind**
RE footprint - solar	*Ha*	*12000*	*96 000*	0,5MW/ha, footprint
RE facilities - solar	*no of facilities*	*6*	*48*	Clusters of 1 GW facilities
RE capacity - wind	***GW***	***4***	***32***	**60 % solar : 40 % wind**
RE footprint - wind	*Ha*	*4000*	*32 000*	1 MW/ha
RE facilities - wind	*no of facilities*	*3*	*21*	Clusters of 1,5 GW facilities

Source: (Schreiner, et al., 2024, p. 25)

While some land near the proposed port and SEZ is suitable for wind and solar energy production, ***it is unlikely to have enough area for the necessary renewable energy capacity***. Due to the considerable depth of the ocean floor near Boegoebaai, offshore wind energy production is unlikely to be a viable option. Additionally, most of the surrounding land is owned by local communities, which often engage in pastoralist agriculture. As a result, it is improbable that these communities would consent to the development of large wind or solar farms on the available green energy sites. Supporting a 5GW electrolyser requires 10GW of green energy, necessitating a land area of 12000ha for solar and 4000ha for wind. Over time, these requirements will rise to 96000ha for solar and 32000ha for wind. Such large installations should be integrated within the REDZ and Power corridors to facilitate easy grid access for energy transmission. Consequently, it is expected that green energy sites will be developed in the broader region and beyond, with the generated power transmitted to the Boegoebaai site predominantly through ESKOM lines. This strategy also means that the impact of these installations will be spread across a vast area and potentially multiple provinces. To ensure a steady supply of green energy, it is advisable to distribute renewable sources, possibly as far as the Western and Eastern Cape. However, when taking into account ecological constraints—such as protected areas, critical biodiversity zones, and threatened ecosystems—alongside physical limitations like the infrastructural constraints of solar and wind farms, fewer areas remain in the region suitable for these new developments. Annexure E provides the results of the analysis conducted to identify potential green energy production sites in this region.

6.3.3.5 Electricity transmission

The ESKOM Transmission Development Plan (TDP) (ESKOM, 2020) outlines two projects initiated in the past decade to enhance the network and facilitate the evacuation of renewable energy from the area. These projects include the Juno-Gromis 400 kV line and the Gromis-Oranjemond 220 kV line, which was built to a 400 kV specification and became operational in 2018. Additionally, the proposed Gromis-Nama-Aggeneys 400 kV line is set to be commissioned in 2026. This project involves constructing a 400 kV line that connects Gromis Substation to Nama Substation, and Nama Substation to Aggeneys Substation, aiming to evacuate renewable generation within the Namaqualand load network. These lines are depicted on the subsequent map as part of the transmission network. The development of the Port and SEZ will necessitate further additions to the transmission network, requiring new lines to supply power to the site. Figure 6-22 illustrates several new transmission lines, including the Juno-Gromis line and the Gromis-Nama-Groeipunt-Aggeneys-Aries lines, which are crucial for transporting power across the region.

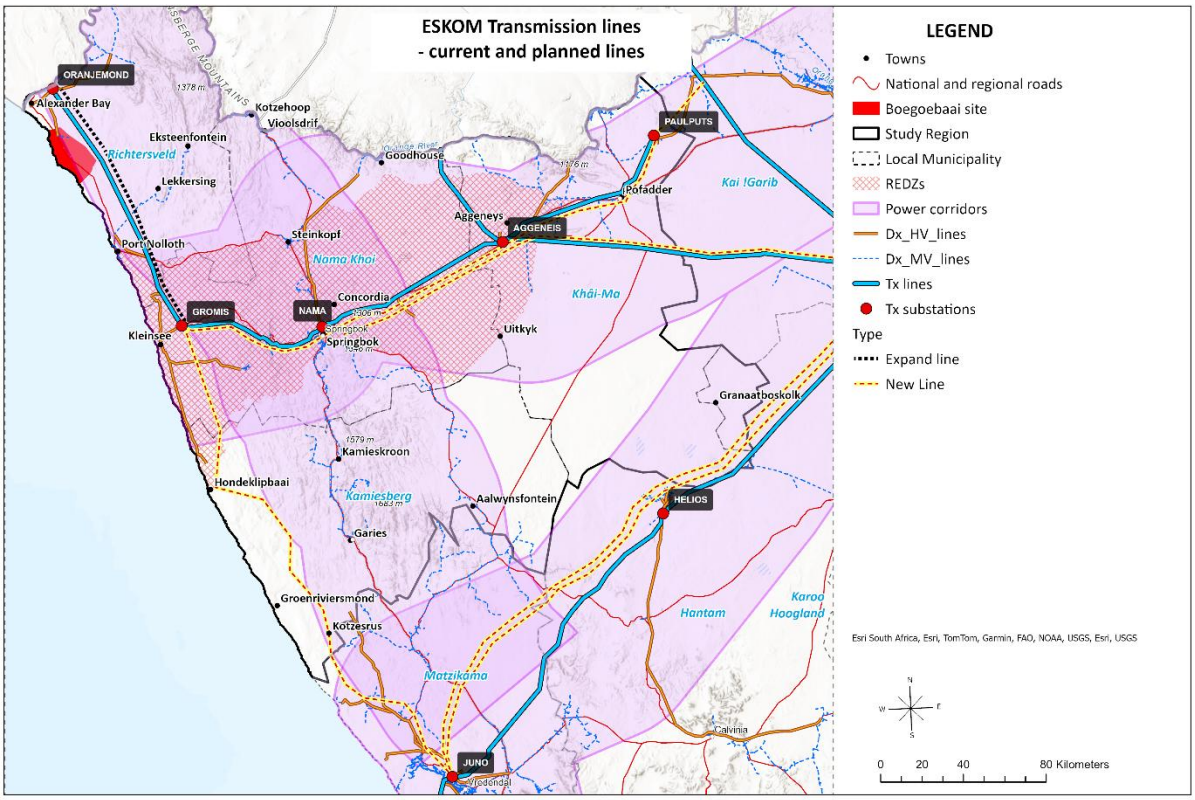


Figure 6-22: ESKOM transmission lines

Source: (Maritz, 2025b)

Prior work has been undertaken initially in 2014 and again in 2019 to undertake Strategic Environmental Assessments (SEAs) for Electricity Grid Infrastructure (EGI) Corridors (Department of Environment, Forestry and Fisheries (b), 2019). The benefit is that developers of large electricity transmission infrastructure that develop within the gazette Strategic Transmission Corridors do not need to undertake a full scoping and EIA process can instead then follow a Basic Assessment Process in Terms of 2014 EIA Regulations (Department of Environment, Forestry and Fisheries (b), 2019). Strategic transmission corridors span much of the region and encompass all current transmission infrastructure. Any new transmission infrastructure expected to be located within these corridors is also included within their coverage. New EGI projects outside these corridors can take between five and ten years to complete. New green energy plants can be operational in a short time, and should new transmission lines be required, this could take longer, placing new power production at risk of not being able to connect the grid. Critically the strategic planning of servitudes needs to be undertaken well in advance of the final planning of power lines. Annexure G lists several activities related to the construction of power lines.

<u>Baseline Scenario</u>

Currently, the region has some green energy applications, but only a few have been implemented. The remoteness of specific areas, along with limited grid infrastructure and environmental considerations, hampers the development of many proposed green energy projects. Consequently, these initiatives will progress but not at the scale necessary for the planned Port and SEZ. Additionally, rising interest in mining north of Springbok increases electricity demand (ESKOM, 2020, p. 77). Therefore, the impact on local towns and settlements, especially in Richtersveld, may be minimal, as growth remains limited and will primarily be felt when green energy projects are approved. Such projects could create jobs, primarily during the construction phase. As mentioned earlier, recent upgrades to transmission lines are also aimed at facilitating the transport of newly generated green energy out of the region.

Small Green Hydrogen Scenario

This scenario requires 10GW of green energy to power a 5GW electrolyser equivalent. Wind and solar power projects near the port and SEZ could provide direct energy to the site (refer to the map in Annexure F). However, if any sites are developed, they likely won't meet the total electricity demand (needing 16000ha). Given that the land surrounding the site belongs to the Richtersveld Sida !Hub Communal Property Association (CPA), it is improbable that they will permit extensive land use due to potential impacts on tourism and their pastoral activities. Additionally, diversifying green energy sources is crucial for ensuring a steady power supply, necessitating the widespread placement of these GE sites across different provinces.

Extra green energy will need to be transmitted via the ESKOM grid to the site. The green energy requirements for Boegoebaai must be considered alongside possible effects on the Government's REIPPP program. However, the SEZ can be directly purchased from independent green energy producers, allowing for power transfer through the ESKOM grid. This enables industrial entities to establish power purchase agreements with IPPs, providing long-term price certainty.

It's recommended that all green energy needs are communicated to ESKOM as soon as possible, impacting their Transmission Development Plan (TDP). According to ESKOM, the TDP plans for a double 765KV line with 400KV interconnectors in the area, which would adequately support initial power needs when combined with direct power production at the site.

Regarding site-specific factors, the land required for solar and wind installations is significant, needing an area of 12000ha for solar and 4000ha for wind. Site location is crucial, particularly about existing grid infrastructure; without it, costly transmission lines would need to be built. The GE site should also be accessible for transporting heavy equipment and construction materials such as solar panels, mounting systems, inverters, wind turbine blades, and tower sections, necessitating the potential development or improvement of access roads, especially if the site is secluded.

It is preferable to house construction workers on-site rather than in regional towns to minimise costs and transportation challenges. The construction phase will see the highest number of personnel on-site. Activities will include land clearing, campsite construction, civil works (like cabling, substations, and foundations), and crucial infrastructure development, particularly road construction. This is especially important for wind farms, where turbine placement varies based on terrain and design, driving the need for roads to facilitate turbine delivery and maintenance. To reduce expenses and environmental impact, road materials are typically sourced from onsite quarries or 'borrow pits'.

Figure 6-23: Example of wind turbine towers with connecting roads (wind turbines in Soetwater in the Northern cape).

Source: (Enel Green Power South Africa, 2024)

Annexure G illustrates the essential skills required for developing a solar energy project. When solar or wind farmland is leased to a developer, it can significantly benefit farmers, rural landowners, and communities facing economic challenges or lacking resources for local development. Additionally, solar and wind farms create job opportunities during both the construction and operational phases, bringing economic advantages to local communities.

These large installations must fit within the REDZ and Power corridors to ensure access to grid infrastructure for transmission. Consequently, it is anticipated that green energy sites will be developed both in the surrounding region and beyond.

Given the extensive scale of wind and solar projects in the area, they hold the potential for socio-economic benefits, including the manufacturing, installation, and maintenance of renewable energy equipment and facilities. Opportunities associated with the green energy sector, particularly supply chains, could be established in the Boegoebaai SEZ, facilitating the execution of green energy projects.

Big Green hydrogen Scenario

In the period following 2035 green hydrogen production is set to increase to reach a capacity of 40GW (estimated by 2050). This increase also requires a concurrent increase in the power delivered to the site. To achieve a 40GW electrolizer capacity 80 GW of green energy is needed at the site. This will result in an increase in the land area required to implement solar and wind production, expanding to 96000 ha for solar and 32000ha for wind respectively. Additional green energy production will need to be developed in the region or beyond, predominantly in the power corridors to reduce grid development costs. Given the objective of not concentrating green energy spatially to ensure constant supply, this would mean such

plants would be developed in locations far from the region, extending to other parts of the Northern Cape and Western Cape (Marais, 2024).

This could potentially have implications for the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) as well as impact on transmission lines. Considering the vast amounts of power consumed at site, the transmission line grid network in this region might not be sufficient to wheel power to the site. Thus, the effects of developing additional green energy plants *will affect the wider region*. The planning and timely extension of ESKOM transmission lines will require advanced planning. Transmission Development Plans need to accommodate the growth in hydrogen production and its increasing energy needs. The planning is especially critical considering the long timelines required for the construction of new transmission lines. Given the time since establishment of initial green energy plants to supply electricity to Boegoebaai GH2, some existing plants could be redeveloped or expanded (considering the use of newer green energy technologies).

6.3.3.6 Port and SEZ site implications

The proposed Boegoebaai Port and SEZ lies at the core of the future industrial development proposals for the region. Apart from its local impacts, the development would also impact the wider region including aspects such as roads, rail, settlements, green energy, employment, etc. It would provide a port to the Northern Cape Province reducing the need to utilise distant national ports. The adjacent SEZ industrial park would extend over an area of about 31000ha when fully developed. The Port, combined with the SEZ, would be significant land use features within the Municipality and as such has implications for municipal planning. The development should be reflected in the Richtersveld Municipality's planning instruments including, for example, the Municipal SDF, IDP and zoning scheme. It is clear when considering the proposed land use components for the SEZ (see Table 6-12), that although the uses are considered 'industrial' the variance in use or feature types requires a more differentiated depiction of land use avoiding single use zoning (Department of Rural Development and Land Reform, 2017). A detailed precinct plan must be established for the development taking cognisance of the layout, land use types allowed as well as ancillary services (Erioloba Consulting, 2024). Table 6-10 highlights the main components for the SEZ divided over two scenarios.

Table 6-10: Development scenarios: SEZ core components.

Aspect	Unit	Small Green Hydrogen Scenario	Big Green Hydrogen Scenario
Electrolyser capacity	GW	5	40
Electrolyser footprint	ha	75	600
GH2 volume	mtpa	0,5	4,0
GH2 storage footprint	ha	250	2 000
Ammonia volume	mtpa	2,8	22,7
Ammonia footprint	ha	57	454
Ammonia storage footprint	ha	28	227
Desalination output volume	Ml/day	36	286
Desalination footprint	ha	7	57
Desalination discharge	Ml/day	48	387
Pipeline intake volume	Ml/day	84	672

Source: (Schreiner, et al., 2024, p. 25)

Baseline Scenario

During this scenario neither the proposed port, nor SEZ development materialise. Limited open pit diamond mining might continue on the proposed site although parts of the terrain have already been mined significantly (see Figure 6-24a). Over time the site will be evacuated and if not rehabilitated, a partially scarred landscape will remain.

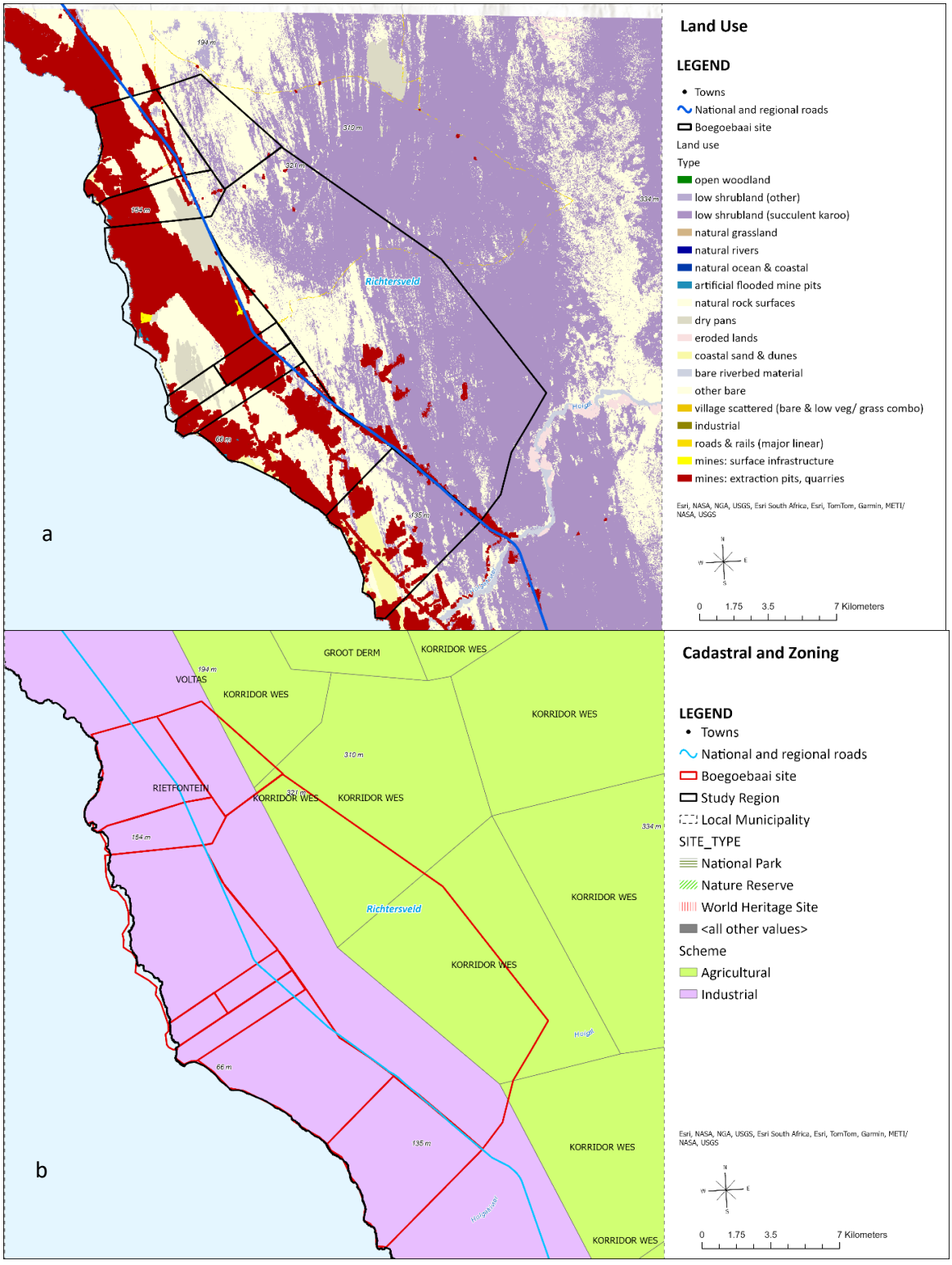


Figure 6-24: Land Use(a) and zoning (b) at site.

Source: (Maritz, 2024d)

Currently the overall land use zoning indicates *industrial* bordered by *agricultural use* (Figure 6-24b). Land use will have to be refined once detailed planning for the SEZ and port has been completed, to reflect a highly structured, phased, mixed-use industrial platform: an industrial cluster anchored in green hydrogen and integrated with the port, internal infrastructure and utilities, environmental conservation areas, and

connecting regional infrastructure. Work Package 1: Strategic Environmental Assessment for the proposed Boegoebaai Port and Special Economic Zone identifies preferred development areas within the SEZ.

The nearby town of Alexander Bay is in decline due to a decrease in diamond mining activities.

Small Green Hydrogen production scenario

Before any development is undertaken a detailed approved precinct plan is required, detailing layout, land uses, services etc. The Port is anticipated to commence first, followed by the phased development of aspects of the SEZ. The Port and SEZ will be the region's focal point of new development. All relevant approvals will, however, be required before construction of any development at the site. During the construction period, the movement of equipment, materials and resources along the N14, N7, and especially the R382 will occur. The interim maintenance work to be carried out by SANRAL will help to maintain the road in the short term only. When considering that the current R382 has not been designed to carry a large number of heavy vehicles regularly, it will eventually be necessary to address the reconstruction of the R382 (TM consulting and Nelutha, 2019a). This will also be beneficial once the port is operational and when large numbers of heavy vehicles transporting manganese to the port commence. A study conducted by Transnet estimated that in year five into port operation, up to 39 trucks per hour will be delivering manganese to the Port (TM consulting and Nelutha, 2019a, p. 23).

Construction material will likely need to be trucked in from the region or areas beyond. Given the size of the Port and the various sections of the SEZ, a significant amount of road construction on site will also be required. Road construction materials will be sourced both commercially and from approved quarries and borrow pits. The identification and permitting of gravel pits will increase during this time, considering the increased need for surfaced roads and road improvements or reconstruction of the R382. Maintaining roads, especially the R382, will be critical to ensure a good level of connectivity to the rest of the region and the towns of Alexander Bay and Port Nolloth.

Considering the range of construction possible during this phase, it is likely that construction site camps will need to be established; however, given the planning objective of not creating new settlements (see the 2024 Richtersveld SDF), careful consideration should be given to where such temporary accommodation should be located. Large temporary settlements would also require water, sanitation, waste disposal, and access to retail and health services. Alexander Bay, as the closest settlement, could serve this purpose; however, the current distressed state of the town signals that before setting up accommodation in Alexander Bay, the infrastructure must be improved. Land use changes and new residential areas will also need to be created in Alexander Bay. Given the financial state of the municipality, it is likely that the key developers of the Port and SEZ will need to invest in Alexander Bay to create a liveable and functioning environment capable of accommodating an influx of primarily temporary workers.

Based on a detailed precinct plan, a more detailed land zoning will be required as well as a change in zoning; the current zoning of some parts of the proposed SEZ is Agriculture. The unique mix of use types within the SEZ will require their respective EIAs and various approvals from relevant authorities. This can include the following:

- **Desalination plant** - Building and commissioning a desalination plant requires various permits and approvals from several State departments. Two key authorisations locally are an **environmental authorisation** in terms of the National Environmental Management (NEMA) Act, No 107 of 1998, and associated EIA regulations, and a **Coastal Waters Discharge Permit** (CWDP), which is issued in terms of the NEMA: Integrated Coastal Management Act, No 24 of 2008, for the discharge of brine generated by a desalination plant into the sea. Separate reports and application processes are required because various government departments or organs of State issue the permits and licences. This will necessitate several detailed, specialist studies, which can be time-consuming. It would take one to two years – potentially more – for all the relevant processes to be completed and permits to be issued (Slater, 2017).

- **Electrolyser plant** – Similarly, the approval and regulation of electrolyser installations generally fall under **the jurisdiction of several regulatory bodies and authorities**, depending on the scope of the

installation. The primary entities involved in approving electrolyser installations include the following: **The Department of Minerals Resources and Energy (DMRE)** is the national government Department responsible for the regulation and development of energy infrastructure, including hydrogen production and the use of electrolysers. **The SABS** is the national standards body which sets and enforces standards for various types of equipment, including electrolysers. Installations must comply with relevant South African National Standards (SANS) to ensure safety and efficiency. **The National Energy Regulator of South Africa** - any large-scale electrolyser installations that are part of the broader energy infrastructure may require NERSA approval. **Local municipalities** may also be involved in permitting and approving electrolyser installations. This is especially relevant for projects involving extensive infrastructure or if local building codes and safety regulations apply. **Department of Environmental Affairs** - Electrolyzer installations, especially large-scale ones, may require an EIA if they are likely to have significant environmental consequences, such as water usage or emissions. The DEA would review the environmental permits and ensure compliance with environmental laws. **The Department of Employment and Labour** ensures that any installation complies with the Occupational Health and Safety (OHS) Act. The large size of the proposed electrolysers might affect the approval process and associated timeframes.

Local municipal bylaws might not sufficiently address electrolyser installations and might require adaptation.

The SEZ and Port will produce wastewater, sewage, and solid waste, which typically form part of municipal systems. Relevant infrastructure needs to be developed to process these items. The institution charged with managing the SEZ will also be responsible for the services within the SEZ.

Large Green Hydrogen Scenario

The initial phase of SEZ development will lay the groundwork for the establishment of components such as water desalination, green hydrogen production and storage, ammonia production and storage and electrolyser installation and implementation. During the later stages, the scale of development will increase as production is ramped up. When new infrastructure - and subsequent SEZ areas - are developed, the standard processes and land use and zoning approvals must be obtained. These expansions will result in periodic construction booms, albeit focussed in particular parts of the overall SEZ.

When hydrogen production reaches larger volumes, the development of pipeline infrastructure to transport the product to Namibia, Saldana Bay and to the eastern part of the province, will become viable. It is assumed that the export of Manganese through the Port is also expected to reach large volumes after the first ten years of operation (first phase). The large amount of mining freight will trigger the introduction of rail as the primary form of transport for mining commodities. Both pipelines and rail lines must be accommodated at the SEZ and Port, respectively.

6.3.4 Estimated project timelines and direct employment

The proposed development of the port and SEZ involves multiple infrastructure components, each requiring dedicated planning, design, construction, and operational activities. Many of these projects will need to be executed simultaneously or in overlapping phases. Several interdependencies exist; for example, while the port will initially focus on exporting manganese, it will also support the export of green hydrogen products. Producing green hydrogen will require the development of solar and wind energy projects, as well as desalination and electrolyser plants.

Additionally, upgrading the R382 is crucial to accommodate the expected surge in freight and other traffic, ensuring efficient access to both the port and SEZ. Table 6-11 provides a high-level overview of the estimated project phases for key infrastructure developments, which in turn is based on project specific assumptions (financing, approvals, labour sourcing and the phasing of projects). The depiction of project timelines and employment is based on available project documentation. While some projects fall within the Richtersveld Municipality, others—such as the proposed rail and pipeline projects—will have a broader regional impact.

It is assumed that some wind and solar plant projects would be developed near the SEZ site, while other projects could occur in the broader region where suitable locational and infrastructural conditions are met, ensuring diversification of green energy resources. The table also indicates that several projects will continue to expand, notably the green energy projects, which must feed into the expanding electrolyser and desalination components. Referencing existing studies, an estimated number of direct construction and operational employment opportunities has been calculated for each project. Due to uncertainties regarding the location of project sites, such as regional green energy (solar and wind) plants, as well as considerations for where construction workers will be accommodated during work in the wider region, estimated direct employment numbers could only be attempted for the Richtersveld Municipality. Furthermore, it remains unclear how many employees might relocate with their families to the region. In some instances, where the region lacks well-developed towns or cities offering various services, the preference may be to work remotely away from their families, especially during temporary construction phases that do not provide long-term employment opportunities beyond these periods. Table 6-12 presents estimates of direct (conservative) employment generated during the construction phases, derived from the available project documentation. Construction is projected to commence three years after the launch of the port and SEZ projects (estimated 2027/28). An estimated 2,618 new employment opportunities would arise around 2028, increasing to 6,538 in 2029. Given the level of skills currently absent in the region, this would attract workers into the area. Direct employment opportunities would fluctuate between 6,538 and 6,336 at the peak of construction activities in the Richtersveld (although some projects would be spread out, and some would migrate away from Richtersveld as rail and pipeline construction progresses into the region). Some of these workers may also bring their families to the region. Following the construction phase and into operations, the number of direct employment opportunities would decline, ranging from 2,026 to 840 (estimates from 2031 onwards), which would more realistically reflect the long-term 'new' residents in the area. Regional and municipal planning strategy documents propose that new incoming residents be primarily accommodated in two towns: Alexander Bay and Port Nolloth. The socio-economic study conducted by SSR (2024), suggested a proportional split between Alexander Bay (35%) and Port Nolloth (65%) in housing these newcomers. This distribution assumes that most individuals will settle in Port Nolloth and Alexander Bay, and that a new "constructors' town" will not be established at the port or SEZ.

Assuming an average household size of 4.3 persons, this would suggest that Alexander Bay could gain between 1,973 direct jobs (resulting in 8,286 people when households are included) at the height of the construction phase, while Port Nolloth could see an increase of between 3,664 direct jobs (yielding 15755 people when households are accounted for). This figure would decline once construction phases are completed and only operational employment remains. It should be emphasized that these figures are derived from preliminary estimates based on pre-study analyses. Comprehensive project planning is required to determine more precise population and household projections; such refined estimates are, in turn, essential for the planning and financing of housing, the design of bulk infrastructure, and the provision of social services.

Some new residents may prefer to live in Springbok, the larger regional centre, rather than in Alexander Bay or Port Nolloth, as it offers a wider range of services, facilities, and amenities. As a result, they may need to commute long distances to the site. Average commuting times of two hours may be further impacted if the road experiences high volumes of heavy vehicle traffic. While smaller towns exist within the Richtersveld, they also have limited facilities and services. Current settlement-related challenges indicate that any significant population growth would require substantial investment to upgrade settlement infrastructure and support its development.

Table 6-11: Timeline for various critical infrastructure items.

Timeline	2025	2026	2027	2028	2029	2030	1st Ship at Berth	2031	2032	2033	2034	2035	2036	2037	Up to 2050	Notes:
Port Landside*[7]	Design		Tender	Construction				*Operation*								Richtersveld focus
External Road*[8]	Design		Tender	Construction				*Operation*								Richtersveld focus
Future Rail*[9]	Pre-planning and Planning		Design					Tender	Construction				*Operation*			Wide regional impact
Future Pipeline Phase 1[10][11]	Pre-planning and Planning	Design	Tender	Construction				Operation								Scenario 1 - Regional impact
Future Pipeline Phase 2								Planning	Design	Tender	Construction			*Operation*		Scenario 2 - Regional impact
Green Energy (S) Direct[12]	Pre-Planning	Planning	Design	Tender	Construction			Operation								Richtersveld focus
Green Energy (W) Direct[13][14]	Pre-Planning	Planning	Design	Tender	Construction			Operation								
Green Energy (Wheel)[15]	Pre-Planning	Planning	Design	Tender	Construction			**Ongoing as separate projects in the region. Linked to Bidding cycle**								Wide regional impact
Electrolizer[16][17]	Pre-Planning	Planning	Design	Tender	Construction			*Operation*					*Planning -expansion*		*Expand Electrolyzer*	Richtersveld focus
Desalination[18]	Pre Planning	Planning	Design	Tender	Construction			*Operation*					*Planning -expansion*		*Expand desalination*	Richtersveld focus

[7] (TM consulting and Nelutha, 2019a)
[8] (TM consulting and Nelutha, 2019a)
[9] (TM consulting and Nelutha, 2019b)
[10] (African Development Bank and SASOL Petroleum, 2002)
[11] (Department of Environment, Forestry and Fisheries, 2019)
[12] (Lochner, Abed, & Antonopoulos, 2022)
[13] (Leguijt, Van den Toorn, Bachaus, & Jongsma, 2021)
[14] (Lochner, Kellerman, Moodley, & Abed, 2021)
[15] (JG Afrika, 2022, p. 16)
[16] (Leguijt, Van den Toorn, Bachaus, & Jongsma, 2021)
[17] (Rhodium Group, 2023)
[18] (CSIR, 2016)

Table 6-12: Employment number for construction and operations - key infrastructure items

Timeline	2025	2026	2027	2028	2029	2030		2031	2032	2033	2034	2035	2036	2037	Up to 2050
Port Landside*	Design		Tender	1738	2078	1656		*1656*	420	420	420	420	420	420	
External Road*	Design		Tender	480	480	480		*20*	*20*	*20*	*20*	*20*	*20*	*20*	
Future Rail*	Pre planning and Planning		Design					Tender	500	500	500	500	*10*	*10*	
Future Pipeline Phase 1	Pre planning and Planning	Design	Tender	400	400	400	1st Ship at Berth	20	20	20	20	20	20	20	
Future Pipeline Phase 2								Planning	Design	Tender	400	400	400	*20*	
Green Energy (S) Direct	Pre-Planning	Planning	Design	Tender	900	900		20	20	20	20	20	20	20	
Green Energy (W) Direct	Pre-Planning	Planning	Design	Tender	680	900		20	20	20	20	20	20	20	
Green Energy (Wheel)[19]	Pre-Planning	Planning	Design	Tender	(900)	(900)		**Ongoing as separate projects in the region. Linked to Bidding cycle**							
Electrolizer	Pre-Planning	Planning	Design	Tender	1000	1000		*300*	*300*	*300*	*300*	*300*	*300*	*300*	*Expand Electrolizer*
Desalination	Pre-Planning	Planning	Design	Tender	100	100		*10*	*10*	*10*	*10*	*10*	*10*	*10*	*Expand desalination*
Employment (some in construction camps)				**2618**	**6538**	**6336**		**2026**	**1310**	**1320**	**1710**	**1710**	**1220**	**840**	

See references in Table 6-13.

Significant construction predominantly affecting Richtersveld LM

Some projects could affect the region, SEZ park growth creating periods of construction boom

[19] Not included in totals.

6.4 RISK ASSESSMENT

SEA risk assessment is conducted at a strategic scale rather than at the detailed level of individual projects. It examines overarching risks and opportunities linked to policies, plans, or programs before specific project designs are developed. This section reflects a risk and opportunity assessment of the key impacts identified. The evaluation in this SEA is mainly measured on the interpretation of the spatial and nonspatial information related to the green hydrogen scenarios specified for this SEA and summarised in this section. The baseline serves as the base against which proposed projects are measured. It must be noted that given the nature of this section, some risks and opportunities are measurable to an extent, and some are qualitative and probabilistic in nature. Examples of similar infrastructure projects implemented elsewhere served as reference cases to help quantify the likely impacts. **Detailed impact can however only be quantified during detailed project planning or impact studies**; this section reflects a summarised compilation of aspects related to several proposed infrastructure items, the likely settlement effects, and the essential planning processes involved. Key risk themes identified include;

- Development planning pressures
- Settlement Infrastructure development and management
- Construction of economic infrastructure

The following table aims to capture the **most relevant measures of risks and examples of potential mitigation measures.**

Table 6-13: Risk & mitigation measures.

Key Risk Area	Measuring Risk - Examples	Risk Mitigation Measures – Examples [Lead and key institutions in brackets]
Development Planning Pressures	• Limited governance capacity for planning, implementation, monitoring, and compliance. • Administrative and technical weaknesses in decision-making processes. • Insufficient involvement of well-capacitated role players in planning and legal processes. • Challenges in securing communal land for development or reaching agreements for its use. • Time and complexity in establishing or expanding servitudes for transport and bulk energy infrastructure. • Volume and technical complexity of applications requiring municipal review and approval (land use change, EIAs, etc.). • Limited intergovernmental and sectoral long-term plans incorporating scenarios and mitigation options. • Inadequate national government investment aligned to local realities and future needs.	• Formulate credible Spatial Development Frameworks (SDFs) to guide development decisions. [Local Municipalities (LM), District Municipality (DM)] • Enact minimum planning bylaws in affected municipalities to close regulatory gaps and enable capacity for enforcement.[Local municipalities] • Review and improve mechanisms for strategic decision-making, negotiating, and management of communal land to support integrated and sustainable development. [DLRRD NC, Traditional councils/communal property associations, affected LMs] • Assess cumulative impacts of land-use changes and related projects at a regional scale to inform sustainable planning. [DLRRD NC, DMs through DDM] • Invest in continuous skills development for municipalities and municipal partners to enhance long-term planning, compliance, development policies, and implementation capacity. [NC COGHSTA with support from SALGA, LG SETA] • Establish region for Regional Development Collaboration and Planning (Examples are Karoo RSDF, Gamagara Mining Corridor Compact approach to activate institutional responses and support capacity. [SALGA, DLRRD NC, four LMs and DM]
Settlement Infrastructure Development and Management	• Existing service delivery backlogs in water, electricity, sanitation, and rising demand. • Shortages in housing and associated expansion of informal settlements. • Limited accessibility of social services and facilities (education, health, sports, waste sites). • High proportion of indigent households. • Elevated unemployment levels.	• Major construction and worker influx should only occur after core water and sanitation upgrades are secured and sustainably operational.[Provincial environmental authority issuing EA; DWS for water use license] • Prioritise housing and service delivery in preferred settlement nodes to manage growth. [LMs and Provincial Human Settlements] • Scale up delivery of housing, infrastructure, and services to meet demand. [LMs, DMs and provincial sector departments]

Key Risk Area	Measuring Risk - Examples	Risk Mitigation Measures – Examples [Lead and key institutions in brackets]
	• Reliance on key investors for regional infrastructure funding. • Constrained municipal financial viability for infrastructure development and maintenance., sports facilities, landfill sites, etc.	• Strengthen municipal financial management, optimise resources, and diversify revenue sources. [LMs, DMs with oversight from National Treasury] • Align bulk services planning to demand within resource and capacity limits, with contingency for surges. [LMs/DMs (bulk services master plans), and DWS/ESKOM/Water boards] • Upgrade and expand social and municipal facilities (education, health, sports, waste management) to meet current and future needs. [LMs/DMs (waste, sports, local roads, community facilities) and provincial departments (health, education, social development)] • Develop applications for co-financed bulk infrastructure [LMs, ISA, Provincial and National Treasury, future Investors]
Construction of Economic Infrastructure (e.g. roads, rail, pipelines, electricity transmission line corridors, and the port and SEZ).	• Heavy vehicle traffic accelerating deterioration of road networks, increasing maintenance needs. • Traffic disruption along the central transport spine to/from the port/SEZ. • Increased road safety risks and incidents, particularly during construction. • Rising road maintenance costs. • Delays in project execution due to regulatory and permitting complexities. • Constraints in acquiring land (private, state, communal) for port, SEZ, and related infrastructure. • Delays in establishing servitudes for rail, electricity transmission, and pipelines. • High construction water demand and delays in water use licensing. • Long-term operational water requirements (e.g., solar plants).	• Implement systematic monitoring of road condition and capacity for proactive maintenance of paved roads such as R382, N7 and N14. [SANRAL (national roads), provincial roads departments, and LMs (local roads)] • Secure sustainable budgets to meet rising maintenance needs.[SANRAL, provincial roads departments, LMs (through their budgets and conditional grants)] • Plan construction camps with municipalities to avoid overburdening local services.[Project proponents and EPC contractors (location, design, funding)] • Assess and strengthen institutional capacity to manage development applications, financing applications, PPPs and licensing efficiently. [DGOC NC COGSTA, Sector departments and LMs] • Simplify and expedite the processes for establishing servitudes for transmission lines and related infrastructure.[National and provincial line departments (DMPR, DFFE, Transport, Eskom/Transnet as SOEs) and DLRRD for land acquisition frameworks]

Key Risk Area	Measuring Risk - Examples	Risk Mitigation Measures – Examples [Lead and key institutions in brackets]
	• Limited availability of construction materials. • Potential delays in electricity infrastructure upgrades to meet port/SEZ requirements. • Additional municipal service demands from construction camps. • High rail construction costs delaying projects and increasing road dependence. • Additional road infrastructure required to access energy and transmission projects.	
Note: This Chapter does not address *onsite* infrastructure development for the port and SEZ.		

6.4.1 Reflecting on risk items

6.4.1.1 Development planning pressures:

Spatial land development planning, land use management, and governance capacity implications: In the area of sustainable development planning and settlement construction and management, there are several key risks associated with the lack of timeous planning and institutional readiness (also see section 7.6). The current mechanisms to process and approve planning applications are not designed to cope with the expected increase in such applications. Should processing of applications linked to the Port and SEZ, settlement development, pipelines, roads, green energy projects be slow and/or be seen as being inconsistent with the principles of fair administration (i.e. fair, open and transparent and without undue delay), there is an increased risk of decisions being challenged (and taken on review), which can significantly harm the commencement of development activities. The capacity constraints with regards to planning could jeopardise the ideals of integration and harmonisation, possibly leading to a lack of social cohesion and social instability in the towns. The lack of long-term environmental and development planning capacity may also result in crisis management, resulting in unsustainable development outcomes. While effective environmental and development planning frameworks are essential, the risk of avoiding unsustainable outcomes can only be avoided if government has the capacity (i.e. funding, human resources, skills) to implement these strategic frameworks and the associated regulatory processes. This must be strengthened within this core region as it is the focus area of several developments. To avoid unfavourable investment conditions especially for local economic development, long-term planning for the identified port and SEZ developments (Scenario 1 and 2) will have to pro-actively consider land use needs and spatial planning implications of, for example, more heavy-vehicle through-traffic affecting towns of Port Nolloth and Steinkopf. The regional development will affect two settlements considerably (Alexander Bay and Port Nolloth), and this could significantly affect housing development and social service provision and place a burden on bulk infrastructure. Smaller settlements need to be protected from unmanaged informal settlement which could place further strain on these communities and endanger local heritage and culture.

Carefully mediating communal land rights for new land development applications: During Apartheid, local people's rights in the region were not acknowledged, and communities were excluded from the use of land and the benefits obtained by others utilising its resources. Corrective measures have ensured land is returned to rightful communities; however, the risk remains that proposed large developments could still exclude the current landowners or not sufficiently benefit them. An historic opportunity currently exists for all stakeholders (including government and the private sector) to demonstrate sensitivity and caring to ensure that the proposed development opportunities provide long term sustainable benefit to the landowners, economically elevating the communities while also protecting local culture and heritage. The area of communal land ownership (CPA in this case) and its use for development is still contested and evolving. Communal land ownership and administration is also a challenge for communities/ community organisations where capacity and institutional readiness can be a challenge (also see section 7.5.4.3.3).

Governmental decision-making will be required around a diverse range of aspects such as: 1) land use change and land development applications for all the port and SEZ project components, 2) the implications of the Port, SEZ (Green Hydrogen components), green energy, pipelines, rail lines on adjacent land uses, 3) the impacts on potential/future spatial development on surrounding areas 4) ensuring the effective involvement of communities, 5) contributions to be paid to municipalities for municipal services, and 6) the possible provision of bulk infrastructure etc. Although many of these aspects, as single stand-alone items, have been addressed in South Africa previously (except for Green Hydrogen), the number and scale of proposed developments that would occur simultaneously is new, especially in this region. The developments will challenge the local aspects of spatial and land use planning legislation, powers and functions of organs of state, provision, maintenance and upgrading of infrastructure, etc.

Appeals processes: Land Use Management Systems of each municipality sets out the appeal process should there be an appeal against a municipal planning tribunal decision. A district municipality may, with the agreement of the local municipalities within the area of such district municipality, establish a Municipal Planning Tribunal to receive and dispose of land development applications and land use applications within the district municipal area (Department of Rural Development and Land Reform (DRDLR) , 2013, p. 44). The Municipal Planning Tribunal handles complaints against a planning decision. An Appeals Authority established in a municipality can decide on an appeal of a decision made by the

Tribunal (Haarhoff, 2022). Municipalities in this region, have technical and professional capacity constraints. The task in supporting these municipalities to be able to process the land use applications that will be needed for the Port and SEZ and all the linked project components as well as settlement growth or boomtown dynamics, is a challenge that must be addressed by provincial governments as a matter of priority. The role of the District Municipality to provide added capacity and planning support should also be considered.

6.4.1.2 Settlement Infrastructure development and management:

Settlement development and service delivery needs: The growth and development of settlements is a normal process that should be sustainable, well planned and executed. Sufficient forward planning would ensure that adequate bulk services are available. Settlement and economic growth in this region have mostly been limited. Going forward, some settlement expansion (Alexander Bay) could be affected by communal land ownership (CPA) and it is likely that infill development should occur first. Alexander Bay might also host a more temporary population due to construction activities at the Port and SEZ. Pre-studies have calculated the estimated social services needed to serve the anticipated (larger) settlement population of both Alexander Bay and Port Nolloth (SRR, 2024). Care must be taken when a portion of the new incoming population is temporary due to construction activity. The key restriction in the development of Alexander Bay is the state of its infrastructure – which needs upgrading to address the needs of the settlements (see 3.3.3). Additionally, the rates and taxes paid by the residents (when Alexander Bay was a mining town costs were much lower than that for the rest of the municipality) could require adjustment which may result in resistance from residents. Port Nolloth is also a town with infrastructure challenges – especially water resources. A new water pipeline from Alexander Bay would solve the problem but funding would be required from, for example, the State or the Port and SEZ developers. Similarly, the town needs to resolve its electricity infrastructure constraints. Further restrictions on the development of settlements are brought about by the availability of financial and management resources to develop and service human settlement expansion. Other large projects in the region such as the Namakwa SEZ should be considered as it would affect other settlements and add to the need for services and bulk infrastructure. Given periods where various projects engage in construction activities, there would be competition for skills and material resources.

6.4.1.3 Construction of economic infrastructure:

Construction materials and resources: The development of the Port and SEZ with its hydrogen production components and desalination plant as well as green energy in the vicinity and beyond in the wider region, will all require substantial construction materials. The following list a few examples of some infrastructure projects and likely construction impacts:

- R382 reconstruction – will require granular graded crushed stone base of 220 500 000m^3, stabilised subbase of 248 000 000m^3 and Asphalt surfacing of 174 195 tonnes (TM consulting and Nelutha, 2019a).

- Unpaved gravel roads will typically require about 1 200 m3 of construction material per layer per kilometre of road and depending on the existing site conditions, anything from one to three layers of material may be required for a new road. Under normal use the upper 150 mm of this material would require replacement every six to ten years.

- Water for road construction - Access to water for construction may be a limiting factor, as typically 84 m^3 (84 000ℓ) per layer per km will be required and needs to be sourced and hauled to site.

- Rail line – the total cut and fill required for the bridges, tunnels and earthworks was calculated to be approximately 100 and 120 million m^3 respectively (TM consulting and Nelutha, 2019b).

Other projects such as solar and wind parks, pipelines as well as all the construction on the SEZ industrial estate will also consume construction materials.

The projected growth in heavy vehicle traffic associated with port and SEZ construction will have a substantial impact on the regional road network, necessitating increased investment in routine maintenance and potentially earlier rehabilitation to ensure safety and serviceability. It is recommended that the rail line be built earlier than initially planned in the preliminary studies, in order to reduce the significant risk posed to the R382 and the towns along its route.

Although for some applications such as roads and rail lines where construction materials will be sourced both commercially and from approved quarries and borrow pits, materials will still have to be brought in from outside the region.

Port and SEZ site Implications: It is likely that the SEZ will be managed and operated by a designated operator or developer (which are either public or private entities) that are responsible for developing, managing, and maintaining the infrastructure and services within the SEZ. The operator is typically in charge of providing essential services such as water, electricity, waste management, roads, telecommunications, and security within the zone. The Richtersveld Local Municipality may still play a role in providing certain public services like emergency services, healthcare, and education that extend beyond the specific needs of SEZ businesses, and which would be located in towns where employees would be housed. The Municipality will also be involved in the broader infrastructure surrounding the SEZ (such as access roads and utilities connecting the SEZ to the surrounding community). Although the appointed SEZ operator is responsible for the planning, construction and supply of infrastructure and utilities within the SEZ (President of the Republic of South Africa, 2014), it still must align to the municipal land use scheme. Given that the responsibility for developing the SEZ lies with the appointed operator or developer, the burden and risk for the Richtersveld Municipality (where capacity constraints would otherwise significantly hamper such items) is reduced.

The proposed Port and SEZ will in essence be a large industrial estate, extending over a large area. As such it will result in a substantial land use change requiring substantial detailed planning. Detailed planning would be the responsibility of the operator or developer. The local municipality hosting the SEZ is generally the primary authority responsible for approving planning and land-use within a spatial development zone. This includes the preparation of zoning schemes, development plans and ensuring that development aligns with the municipal IDP and SDF. A remaining challenge is the land ownership or land control of the SEZ land, which according to the SEZ Act needs to be transferred to the entity governing the SEZ. Unless this is addressed at the start of the initiative, it would hamper all subsequent projects. It is also likely given the capacity constraints at the Richtersveld Municipality (SEZ host) that this issue will be addressed by NCEDA and Transnet, the lead institutions driving the SEZ and Port component respectively.

6.4.2 Reflecting on the core risk themes outlined above, it is evident that institutional and infrastructure upgrades must be implemented before substantial development takes place in the region; otherwise, the overall sustainability of the project could be jeopardized.Measuring risk and opportunity

SEA risk assessment works by systematically evaluating the strategic risks and opportunities associated with proposed policies, plans, or programs before detailed project design occurs. The process typically involves identifying major risk themes relevant to the project (like institutional capacity, settlement services, or infrastructure construction), and assessing each risk by combining consequence (the severity of impact across environmental, social, economic, and institutional dimensions if it occurs) with likelihood (the probability it will actually happen given baseline conditions and proposed mitigation). [20]

[20] Uncertainty, implementation failure and funding gaps are handled qualitatively within the risk-rating logic (and through conservative assumptions),rather than via a separate numeric 'weight', they are built info how likelihood and consequence are judged, and how precautionary the overall assessment is.

6.4.2.1 Defining consequence- and benefit categories

Table 6-13Table 6-14 lists both the positive and negative consequence categories for identified impact themes. It reflects the core elements for each impact theme, measured in extent ranging from 'slight' up to 'extreme', which represents the highest category.

6.4.2.2 Risk and opportunity assessment

Predefined risk and opportunity categories were established by the SEA team and is indicated in Table 6-15 (Schreiner, et al., 2024). Risk or opportunity is reflected for each impact theme and each scenario using these risk and opportunity categories.

Table 6-16 reflects the risks associated with a negative impact. It indicates the main receiving environments and then categorises the **consequence, likelihood and risk** associated with each scenario considering the likely situation before-, and after management actions have been implemented[21].

6.4.2.3 Description of risk themes

Development Planning Pressures

This theme primarily focuses on the municipality's ability to undertake strategic planning and development control. Strategic planning encompasses land use, infrastructure, and land development, as well as key municipal functions, including technical and planning tasks, and the processing of approvals through a district planning tribunal mechanism. It also involves the municipality's capacity to evaluate and process applications, provide decision-making support, and implement necessary changes to planning documents and systems. Additionally, this extends to other government departments or agencies for matters that fall outside the municipal scope.

Settlement infrastructure and service development and management

Towns like Alexander Bay and Port Nolloth have been identified as key receiving areas, expected to experience significant growth and increased pressure to accommodate both temporary and permanent new residents due to proposed projects in the region. Other towns likely to face increased settlement pressures include Steinkopf and the Springbok area. This theme highlights several issues affecting these communities *related to infrastructure development*:

There are significant backlogs in essential infrastructure and services, such as water, electricity, and sanitation services. Moreover, the existing infrastructure may not be adequate to support the anticipated population growth and subsequent expansion. Municipal capacity and available resources to ensure sustainable service delivery are currently insufficient, necessitating external funding or developer contributions for infrastructure development. Additionally, the need to support indigent populations, coupled with limited municipal income, leads to a shortfall in funding, making it difficult to effectively manage settlement growth (also see section 7.6.2).

Construction of (economic) large-scale infrastructure projects

Economic infrastructure encompasses a range of large-scale projects, including new rail lines, electricity transmission lines, hydrogen pipelines, and road improvements and construction. It also covers green energy initiatives and the focused development of the Port and SEZ

Given the similarities between these projects, they face common challenges, such as land acquisition and rights and servitude establishment, as well as the strain on limited road infrastructure (specific routes) needed to transport equipment, materials, people, and other freight to- and from- the region. The

[21] Uncertainty about data, future conditions or implementation is then reflected by: inflating likelihood (because failure is more likely), inflating consequence (because worst-case outcomes cannot be ruled out), or explicitly assigning a more conservative risk class when confidence is low.

construction phase will also increase pressure on essential resources (particularly water) and requires accommodation for temporary workers, often in temporary construction site camps that rely on municipal services. Due to the interconnected nature of these projects, detailed pre-planning and coordination during both the planning and implementation phases are crucial to ensure the successful operation of all infrastructure initiatives.

Table 6-14: Consequence categories.

Theme/receptor	Negative consequence (-)				
	Slight	Moderate	Significant	Drastic	Extreme
1. Development Planning Pressures All LMs; Core focus = Richtersveld municipality.	Slight demand for strategic planning and development control increases pressure on existing capacity. Planning for infrastructure development leads to a slight increase in pressure on the regulatory system, including processes for obtaining rights and permits. Minor delays or inefficiencies in project execution, with no significant cost overruns.	Increasing demand for strategic planning and pressures on the regulatory system i.e. development rights, land availability and permits, results in pressure on multiple municipal and agency functions. Some disruptions to timelines and budgets, requiring additional planning and resource allocation.	Increasing demand for strategic planning and pressures on the development and land management system and processes exceed the capacity of multiple spheres of government and agencies, requiring enhanced planning capacity. Major financial and logistical challenges, resulting in extended delays and requiring large-scale interventions.	Rapidly increasing demand for strategic planning and development control in multiple government and agency spheres overburdens the regulatory system, resulting in delays that cause the loss of investment opportunities. Severe construction setbacks, leading to cascading impacts on project viability and regional infrastructure goals.	Extreme pressure on the strategic planning and development control results in the system's collapse, requiring intervention. Broad-scale development of a rapidly increasing number of infrastructure projects lead to extreme delays in the regulatory process. Total project failure, resulting in economic losses, legal disputes and abandonment of key infrastructure initiatives.
2. Settlement infrastructure and service development and management Esp. Alexander Bay and Port Nolloth, Steinkopf and Springbok-settlement cluster.	Migration can be partially accommodated with only a slight increase in infrastructure and service backlogs.	The increasing number of migrants places more significant pressure on multiple municipal and agency functions, resulting in growing infrastructure and service provision backlogs.	The increase in migration is exceeding municipal and agency capacity to deliver infrastructure services, leading to growing informal settlements.	Rapidly increasing demand for infrastructure and services largely overburdens multiple municipal and agency functions, significantly increasing informal settlement.	Extreme levels of in-migration lead to a severe increase in infrastructure and service backlogs and a rapid expansion of informal settlements.
3. Construction of economic/large-scale infrastructure projects Road-, Rail-, Pipeline-, Transmission corridors, Green energy project, Port	The construction of infrastructure projects leads to a slight increase in pressure on the capacity of existing physical infrastructure and	The increasing construction of infrastructure projects places greater pressure on the capacity of physical infrastructure to	Increasing construction of infrastructure projects results in the capacity of physical infrastructure to accommodate increased settlement and the	The rapid construction of an increasing number of infrastructure projects results in the capacity of physical infrastructure (especially the road,	Broad-scale construction of a rapidly increasing number of infrastructure projects leads to the physical infrastructure (especially the road, water and sanitation

and SEZ.	services to accommodate increased settlement and the movement of people, construction equipment, and materials.	accommodate increased settlement. The movement of people, construction equipment, and materials is becoming increasingly limited.	movement of people, construction equipment, and materials to be exceeded, resulting in delays and increased costs.	water and sanitation networks) to accommodate increased settlement and the movement of people, construction equipment, and materials to be drastically exceeded. The above results in loss of investment due to delays and increased costs.	networks) not being able to accommodate increased settlement and the movement of people, construction equipment, and materials. The above results in significant loss of investment and the termination of projects.
Theme / receptor	**Positive consequence (+)**				
	Slight	**Moderate**	**Significant**	**Drastic**	**Extreme**
1. Settlement Infrastructure Development Especially in Richtersveld (Port Nolloth and Alexander Bay)	Infrastructure backlogs are stabilised and not increased.	Beyond reducing infrastructure backlogs, new investment enables the restoration of existing infrastructure.	Infrastructure backlogs are eradicated. Additional infrastructure for water, electricity, and roads enables some settlement growth.	Infrastructure development enables the considerable expansion of settlements, increasing demand for services and economic investment.	Broad-spectrum investment in settlement infrastructure results in the provision of higher-order facilities. This leads to an increase in population and employment opportunities, which attracts further economic investment and increases municipal income overall.

Table 6-15: Predefined risk/opportunity categories to measure Risk or Opportunity.

RISK (-)		OPPORTUNITY (+)	
VERY LOW	Almost indiscernible negative impact.	Almost indiscernible positive impact.	VERY LOW
LOW	Slight negative impact, limited extent, and short duration, well within tolerance.	Slight positive impact, very localised, well below expectations.	LOW
MODERATE	Substantial impact, but less than major; within tolerance and below limits of acceptable change.	Substantial positive impact, but mostly short term, and spatially limited.	MODERATE
HIGH	Major consequence, approaching tolerance and limits of acceptable change.	Highly desirable impact, major medium to long term positive impacts across a broad range of stakeholders at local or regional scales.	HIGH
VERY HIGH	Extremely negative impact, persistent/long lasting, beyond tolerance and limits of acceptable change.	Highly desired, grandiose long term positive impacts across a broad range of stakeholders at local, regional, national, and/or international scales.	VERY HIGH

Source: (Schreiner, et al., 2024)

Table 6-16: Risk associated with a negative impact.

Negative impact	Scenario	Spatial receiving environment / receptor	Without management			With management		
			Consequence (-)	Likelihood	Risk	Consequence (-)	Likelihood	Risk
1. Development Planning Pressure	S0: BASELINE	**Richtersveld** (Primary Receiver)	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY LIKELY	VERY LOW
	S1: SMALL GH2		DRASTIC	DEFINITE	VERY HIGH	MODERATE	DEFINITE	MODERATE
	S2: BIG GH2		SIGNIFICANT	DEFINITE	HIGH	MODERATE	DEFINITE	MODERATE
	S0: BASELINE	**Kamiesberg, Nama Khoi, Khai-Ma** (Rest Of Region)	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		SIGNIFICANT	MORE LIKELY	HIGH	MODERATE	MORE LIKELY	MODERATE
	S2: BIG GH2		SIGNIFICANT	MORE LIKELY	HIGH	MODERATE	MORE LIKELY	MODERATE
	S0: BASELINE	**District, Province and National** (Incl. Agencies: NCEDA, COGSTA)	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		DRASTIC	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		SIGNIFICANT	DEFINITE	HIGH	MODERATE	DEFINITE	MODERATE

Baseline: Given the current low levels of development pressure and limited land use applications, the existing District Municipal Tribunal mechanism is sufficient. A key mitigation would be ensuring that municipalities employ qualified planners to manage ongoing applications effectively.

Small Green Hydrogen Scenario: A significant increase in land use applications is anticipated due to the wide range of developments in the region, with Richtersveld particularly affected. The consequences could be **severe**, as current systems are not equipped to manage a constant high volume of applications. Institutional complexity and the large number of role players will compound the challenge. Additional risks include delays from land ownership disputes, particularly unresolved CPA concerns, which could stall project implementation. A more effective and capacitated planning mechanism must be established to manage the increased workload. Mitigation should also address land-related issues, including the establishment of servitudes required for transport infrastructure.

Big Green Hydrogen scenario: High levels of land use pressure are expected to continue, driven by regional infrastructure such as green energy projects, pipeline expansions, and a new rail line. These developments will trigger land use processes across multiple municipalities. The improved planning mechanisms introduced in the Small Green Hydrogen scenario would remain essential. If not implemented, the consequences could be **severe**; however, with effective mitigation in place, the impact is expected to be **moderate**.

Table continues next page.

Negative impact	Scenario	Spatial receiving environment / receptor	Without management			With management		
			Consequence (-)	Likelihood	Risk	Consequence (-)	Likelihood	Risk
2. Settlement Infrastructure Development & Management	S0: BASELINE	**Richtersveld** (Alexander Bay And Port Nolloth)	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		EXTREME	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		EXTREME	VERY LIKELY	VERY HIGH	MODERATE	DEFINITE	HIGH
	S0: BASELINE	**Nama Khoi** (Steinkopf and Springbok Settlement Cluster)	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		SIGNIFICANT	MORE LIKELY	HIGH	MODERATE	MORE LIKELY	MODERATE
	S2: BIG GH2		SIGNIFICANT	MORE LIKELY	HIGH	MODERATE	MORE LIKELY	MODERATE
	S0: BASELINE	**Khai-Ma** (Poffadder And Aggeneys)	SIGNIFICANT	LIKELY	HIGH	MODERATE	LIKELY	MODERATE
	S1: SMALL GH2		SIGNIFICANT	LIKELY	HIGH	SLIGHT	LIKELY	MODERATE
	S2: BIG GH2		MODERATE	LIKELY	MODERATE	MODERATE	LIKELY	MODERATE
	S0: BASELINE	**Rest Of Settlements**	SLIGHT	LIKELY	VERY LOW	SLIGHT	LIKELY	VERY LOW
	S1: SMALL GH2		MODERATE	LIKELY	MODERATE	SLIGHT	LIKELY	LOW
	S2: BIG GH2		MODERATE	LIKELY	MODERATE	SLIGHT	LIKELY	LOW

Baseline: At present, pressure on land development and land use applications is low, reflecting modest growth rates and prevailing economic constraints. Current demand is concentrated in Poffadder and Aggeneys (linked to the Namakwa SEZ), and in Springbok, given its regional role and proximity to mining activity.

Small Green Hydrogen Scenario: Extreme pressure is expected due to a wide range of projects and associated construction activities. Construction jobs and the establishment of construction camps, together with increased in-migration, will place significant strain on towns in the Richtersveld, with spillover effects into other settlements if not managed. Additional direct and indirect pressures from port and SEZ-related projects — including energy, roads, pipelines, and associated logistics — will drive settlement and housing demand growth in Port Nolloth and Alexander Bay in particular. With mitigation, the overall consequences are considered moderate.

Big Green Hydrogen Scenario: Settlement pressure will remain high, driven by ongoing regional growth and new energy, rail, and pipeline projects. While the Richtersveld will continue to face significant demand, pressure is likely to shift to other towns as construction activity expands across the region. Additional indirect pressures will arise from housing demand, enterprise development, and informal settlement growth. With appropriate mitigation, the consequences are expected to be moderate.

Table continues next page.

Negative impact	Scenario	Spatial receiving environment / receptor	Without management			With management		
			Consequence (-)	Likelihood	Risk	Consequence (-)	Likelihood	Risk
3. Construction of Economic Infrastructure Projects	S0: BASELINE	1. Port & SEZ	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		EXTREME	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		DRASTIC	DEFINITE	VERY HIGH	MODERATE	DEFINITE	MODERATE
	S0: BASELINE	2. Road Corridor (focus on R382)	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		EXTREME	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		SIGNIFICANT	LIKELY	LOW	MODERATE	UNLIKELY	LOW
	S0: BASELINE	3. Pipeline Corridors	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		EXTREME	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		EXTREME	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S0: BASELINE	4. Rail Corridor	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S2: BIG GH2		EXTREME	DEFINITE	VERY HIGH	SIGNIFICANT	DEFINITE	HIGH
	S0: BASELINE	5. Transmission Corridors	SLIGHT	VERY LIKELY	VERY LOW	SLIGHT	LIKELY	VERY LOW
	S1: SMALL GH2		DRASTIC	DEFINITE	VERY HIGH	MODERATE	DEFINITE	MODERATE
	S2: BIG GH2		DRASTIC	DEFINITE	VERY HIGH	MODERATE	DEFINITE	MODERATE
	S0: BASELINE	6. Green Energy Projects/ Corridors/Sites	MODERATE	LIKELY	MODERATE	SLIGHT	LIKELY	LOW
	S1: SMALL GH2		EXTREME	DEFINITE	VERY HIGH	SUBSTANTIAL	DEFINITE	HIGH
	S2: BIG GH2		DRASTIC	DEFINITE	VERY HIGH	MODERATE	DEFINITE	Moderate

Baseline: Roads such as the R382, N7, and N14 currently experience low traffic volumes and receive routine maintenance. No rail or pipeline infrastructure is present or anticipated in the near term. Green energy development is likely but at a modest scale, with relatively limited activity in the Richtersveld municipality. Some pre-existing wind and solar projects are possible under the REIPPPP, though continuation remains dependent on private developers. Minor Eskom transmission upgrades are underway to improve electricity access to selected settlements.

Small Green Hydrogen Scenario: A high level of risk is anticipated as multiple linear and energy infrastructure projects commence simultaneously. Alignment planning and the establishment of servitudes for roads, pipelines, and transmission corridors, together with construction activities, will exert wide-ranging effects on settlements and the broader development fabric — especially in the Richtersveld. Key pressures include:

- Materials and resources: high demand for construction materials, borrow pits, and water (including borehole drilling).
- Labour and accommodation: influx of a large construction workforce requiring accommodation, either in settlements or through the establishment of construction camps.
- Land use and permitting: numerous applications and EIAs required for sites, servitudes, and access roads.
- Transport impacts: construction of gravel access roads along all transport corridors (excluding the R382), and gas pipelines aligned to existing road or energy transmission corridors where possible.

Large areas will be affected by infrastructure footprints, with possible conflict over land use (particularly in CPA areas used by pastoralists). Clearing of sites and construction of new roads will add to cumulative pressures. The precise location of renewable energy sites remains uncertain, but diversification strategies suggest projects will extend into the wider region and other provinces.

Big Green Hydrogen Scenario: Infrastructure pressure will remain high with the expansion of pipelines and the introduction of a new rail line. Rail development, in particular, will require extensive land acquisition, servitudes, access roads, and will have significant planning and environmental impacts on the landscape. Increased heavy vehicle traffic will place additional strain on existing roads. Renewable energy projects will continue to expand, though Richtersveld is likely to face less pressure relative to other parts of the region and adjoining provinces. As with the earlier phase, sites will require clearing, new access roads, water abstraction (including boreholes), and the establishment of construction camps. Land use applications and EIAs will continue at scale, supported by new REIPPPP calls to meet large energy requirements.

Table 6-17: Opportunity associated with a positive impact.

Positive impact	Scenario	Spatial receiving environment / receptor	Without management			With management		
			Consequence (+)	Likelihood	Opportunity	Consequence (+)	Likelihood	Opportunity
4. Settlement Infrastructure Development	S0: BASELINE	Port Nolloth and Alexander Bay	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		MODERATE	DEFINITE	MODERATE	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		MODERATE	DEFINITE	MODERATE	SIGNIFICANT	DEFINITE	HIGH
	S0: BASELINE	Steinkopf and Springbok cluster	SLIGHT	VERY UNLIKELY	VERY LOW	SLIGHT	VERY UNLIKELY	VERY LOW
	S1: SMALL GH2		MODERATE	DEFINITE	MODERATE	SIGNIFICANT	DEFINITE	HIGH
	S2: BIG GH2		MODERATE	DEFINITE	MODERATE	SIGNIFICANT	DEFINITE	HIGH
	S0: BASELINE	Pofadder and Aggeneys	MODERATE	MORE LIKELY	MODERATE	SIGNIFICANT	MORE LIKELY	MODERATE
	S1: SMALL GH2		MODERATE	MORE LIKELY	MODERATE	SIGNIFICANT	MORE LIKELY	MODERATE
	S2: BIG GH2		MODERATE	MORE LIKELY	MODERATE	SIGNIFICANT	MORE LIKELY	MODERATE
	S0: BASELINE	Rest of Settlements	SLIGHT	LIKELY	VERY LOW	SLIGHT	LIKELY	VERY LOW
	S1: SMALL GH2		SLIGHT	LIKELY	VERY LOW	SLIGHT	LIKELY	VERY LOW
	S2: BIG GH2		SLIGHT	LIKELY	VERY LOW	SLIGHT	LIKELY	VERY LOW

Baseline: Minimal new development takes place in the region, limiting opportunities to improve or expand settlement infrastructure such as roads, water, sanitation, waste removal, electricity, and social facilities. Some settlements, including Aggeneys and Pofadder, benefit from investment associated with the Namakwa SEZ in their vicinity (unrelated to Boegoebaai). However, most other settlements do not experience significant investment or growth, and infrastructure conditions therefore remain largely unchanged.

Small Green Hydrogen Scenario: The development of the Port and SEZ is anticipated to drive renewed interest and investment in nearby settlements to accommodate both permanent residents and temporary construction workers. Port Nolloth and Alexander Bay will be the key beneficiaries given their proximity to the development site. The resulting demand for services will catalyse infrastructure investment to strengthen these towns and relieve pressure on already strained systems. Additional benefits are expected in Steinkopf and Springbok (and surrounding areas), while Pofadder and Aggeneys continue to gain from the Namakwa SEZ development.

Large Green Hydrogen Scenario: Ongoing investment in the SEZ, Port, new rail and pipeline infrastructure, and expanding green energy projects continue to enhance settlement infrastructure in towns closest to these developments. If investment flows are effectively managed and coordinated, several towns across the region benefit substantially. Settlements located further from the Port and SEZ also experience improvements, albeit on a smaller scale, through broader regional economic spillovers and service investments.

6.5 MANAGEMENT GUIDELINES AND MONITORING REQUIREMENTS

6.5.1 Establishing a planning support unit/function to enhance shared capacity

As mentioned earlier in this section, the capacity and readiness, especially of the four focal local municipalities to deal with implementing a host of infrastructure projects, related land use issues, and the anticipated settlement related implications (planning and services), needs to be enhanced. If not addressed, the affected municipalities are expected to struggle to handle the increased planning needs and regulatory challenges. It is equally important that municipalities ensure compliance with planning regulations (and plans), which implies monitoring and enforcement. Currently, staffing at the four affected municipalities is insufficient to monitor projects and enforce bylaws effectively. The Namakwa District Municipality supports these municipalities, but its capacity is also constrained. The situation is made worse by the vast distances to be covered by officials to visit settlements and projects.

The following are envisioned to address these constraints.

- Communication and information sharing between the affected municipalities (including the Namakwa District) should be enhanced. Several projects cross municipal boundaries, which requires alignment.

- The use of shared geospatial data is also proposed (above).

- Given the newness of some of the proposed developments (unfamiliar to the planners in the region), it would be beneficial to develop the capacity of these and other municipal officials (*mainly focussed on Hydrogen production and Green Energy*).

- Expand the human resource capacity (additional staff, especially registered planners, sharing skills and experience).

- The establishment of a specialised planning unit or relevant mechanism that is responsive to the likely increased planning workload. This could also be the mechanism by which the national and provincial governments can provide support..

- The planning support unit/function is envisaged as a shared capacity mechanism hosted at district and/or provincial level (for example within the Namakwa District Municipality and/or relevant provincial department), with a mandate to support, not replace, municipal planning powers under SPLUMA.

- Such a unit/function would require a dedicated budget and staffing, access to specialist technical support, and clear terms of reference that define its advisory role, coordination functions and reporting lines.

- The land use decision-making authority remains with the Municipal Planning Tribunals and councils as provided for in SPLUMA, and that the support function is intended to strengthen, rather than shift, these statutory roles.

It should be noted that municipal financial constraints currently limit the appointment of additional skilled technical and planning staff. Thus, the cost for providing added support will have to be addressed.

Capacity development, training and empowerment: One of the significant mitigation factors critical to planning, implementation, monitoring and adaptation will be increasing the capacity of the relevant settlement planning, service delivery, integrated planning, and other authorities in the area. Building capacity and expanding the number of planners in municipalities could address this, but this requires resources and may not be done to the extent needed due to funding constraints. It also takes time to ensure the desired results (Figure 6-25).

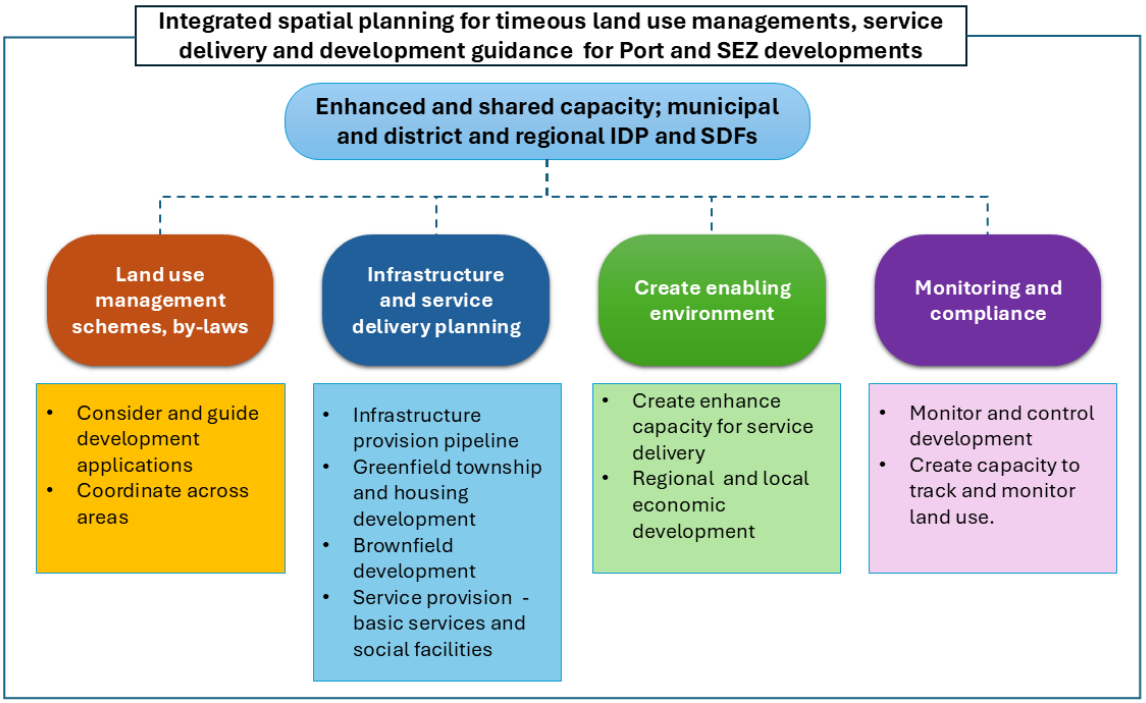


Figure 6-25: Importance of proactive long-term planning instruments and capacity

Source: (Van Hyussteen, et al., 2016, pp. 18-60), modified.

Local planning officials must be capacitated and informed to provide the necessary enabling and regulatory services. Leading investment and/ or development institutions include NCEDA, Transnet, SASOL, SANRAL, ESKOM, Department of Energy, and the DTIC. Their investment is critical to ensure success, and their active participation in the planning activities is of critical importance. The role and support of the South African Local Government Association (SALGA), Department of Rural Development and Land Reform, and Department of Cooperative Government and Traditional Affairs can also aid the planning and development efforts.

Regional specialist capacity: The following will be required:

- Specialist support for baseline studies;
- Specialist studies and dedicated capacity to support SDF and land use management scheme development, with possible appropriate zoning layers for multiple purposes (considering a variety of legal considerations)
- Specialist studies and advice in considering land use applications. There is scope in terms of SPLUMA for a municipality to appoint technical advisers to a municipal or 'shared' planning tribunal to assist with more complex decisionmaking
- Specialist studies to determine relevant development contributions related to the impact on infrastructure and services'
- Specialist support with adaptation of sector plans and strategies
- Monitoring and control, which includes support and control of land use practices, and
- The establishment of a dedicated task team

Precinct plans for the SEZ will be required to detail all developments affecting land uses, the risks involved, and the regulations to be satisfied.

6.5.2 Effective and efficient land use management and regulatory environment

All municipalities in the region have land-use schemes and related procedures for development and land-use applications, in line with SPLUMA. However, limited planning capacity – particularly the small number of registered planners – hampers the effective operation of these systems, especially under conditions of rapid growth. The District Municipal Planning Tribunal, which currently convenes quarterly, is the main mechanism for handling land development applications, but it is unlikely to manage the anticipated surge in applications associated with the port, SEZ and related infrastructure. To reduce these risks and ensure an effective and efficient land use management and regulatory framework, the following minimum conditions should be in place before any major Green Hydrogen-related land development applications are approved.:

- Relevant municipal IDPs and SDFs must be reviewed and revised to integrate the port, SEZ and related infrastructure corridors, and must be formally approved in accordance with the Municipal Systems Act.

- Municipal SPLUMA by-laws, land use schemes and Municipal Planning Tribunals must be fully functional, with meeting schedules, procedures and institutional support that can accommodate the higher volume and complexity of land development applications, ensuring they are processed within reasonable timeframes. A planning support unit/ function is also proposed (section 6.5.1) to expand the planning support functions.

- Existing land use schemes should be broadened and updated, where required, to cater for the complete spectrum of proposed land uses and to promote systematic, periodic review rather than ad hoc amendments.

- Standardised land access and servitude procedures, including those relevant to communal land and CPAs, must be agreed upon by the appropriate spheres of government and affected communities, and then applied consistently across all projects.

- Municipalities should receive support through project-specific planning information: the detailed planning for each major project, and its consequences for municipal functions, must be recorded and communicated in good time so that it aligns with municipal planning and budgeting cycles.

- Suitable GIS-based land use management systems, whether internally managed or supported by external service providers, should be implemented to enable real-time monitoring of land use applications and planning decisions in the core region.

To put these measures into practice, coordinated capacity-building and strengthening of existing planning resources (including more personnel and technical assistance) will be necessary, and governance structures must continue to operate in an open and transparent manner.

6.5.3 Combined planning of Projects

In developing the port and SEZ, numerous large-scale infrastructure projects (such as renewable energy facilities, transmission lines, pipelines, rail links and bulk services) will be designed and rolled out, often with strong interdependencies (for instance, shared access roads and common infrastructure nodes). Taken together, these initiatives affect municipal responsibilities and settlements, and may further burden municipalities whose capacity is already limited. To minimise the risk of piecemeal development and uncontrolled cumulative impacts, integrated planning of these projects should be put into practice through the following measures:

- An intergovernmental project register for all major Boegoebaai-related infrastructure must be created, kept up to date, and used to coordinate project sequencing, routing and scheduling.

- Regular multi-stakeholder planning forums (at least once a year) including affected local municipalities, the Namakwa District Municipality, relevant provincial departments and national SOEs must be held to align project pipelines with municipal IDPs, SDFs and infrastructure plans, and to jointly evaluate cumulative impacts, skills demands and labour requirements.

- Major environmental and land-use authorisations for green hydrogen-related projects should, wherever feasible, be synchronised with IDP/SDF cycles and with each other so that cumulative impacts and infrastructure capacity are addressed in an integrated way.

- Governance frameworks for the port and SEZ should incorporate a balanced mechanism ensuring that municipalities, communities and other affected stakeholders are meaningfully represented, thereby preventing a situation in which key project proponents hold disproportionate decision-making authority (MMSD, 2002).

6.5.4 These tools are intended to translate the idea of integrated planning into practice and to provide a concrete basis for managing cumulative impacts and institutional capacity pressures.Financial support

Pre-studies and recent assessments of the core municipalities show that they lack the financial capacity to clear existing infrastructure backlogs or to fully fund all new infrastructure needed for the port and SEZ, especially in smaller settlements (DBSA, 2024). To ensure strategic feasibility and prevent excessive strain on municipal finances, the following financial conditions are particularly important:

- Key bulk infrastructure needs (notably water, sanitation, electricity and primary access roads) must be clearly identified in municipal and sector infrastructure plans, with indicative funding sources (such as national and provincial grants, SOE investments and/or developer contributions) allocated to each item.

- For any infrastructure that is a prerequisite for major approvals, funding must appear in the relevant Medium-Term Expenditure Frameworks, municipal budgets or in signed finance agreements before any construction-phase approvals proceeds.

- A transparent system for developer contributions and cost-sharing to support municipal and bulk infrastructure must be agreed upon between SEZ governance structures, municipalities and relevant departments, and consistently applied to green hydrogen-related projects.

- Where municipalities are unable to finance required infrastructure, the institution leading the port and SEZ (together with associated partners) should, subject to future agreements, help fund the necessary enabling infrastructure in a way that is consistent with national infrastructure funding and SEZ policy frameworks.

These conditions acknowledge that the mitigation measures and development pathways outlined in this chapter rely on concrete, secured financial commitments, rather than on unfunded expectations.

6.5.5 Sustainable settlements and service delivery

The growth and evolution of settlements is a natural process that should occur in a sustainable, well-planned and properly implemented manner. Adequate forward planning is required to ensure that sufficient bulk services are in place. To date, settlement and economic growth in this region have largely been constrained. In future, certain settlement expansion (for example in Alexander Bay) may be influenced by communal land ownership (CPA), and it is probable that infill development will need to be prioritised. Alexander Bay could also accommodate a more transient population associated with construction activities at the Port and SEZ. Pre-feasibility studies have already estimated the social services required to support the expected larger populations of Alexander Bay and Port Nolloth (SRR, 2024). Caution is necessary when a share of the incoming population is temporary and linked to construction phases.

The primary limitation to Alexander Bay's development is the condition of its infrastructure, which must be upgraded to meet settlement needs. Furthermore, adjustments to property rates and taxes may be necessary (historically, as a mining town, Alexander Bay's costs were substantially lower than those in the rest of the municipality), and this could trigger resistance from residents. Port Nolloth similarly faces

infrastructure constraints, particularly regarding water supply. A new water pipeline from Alexander Bay could resolve these shortages, but would require external funding, for instance from the State or from the Port and SEZ developers. The town also needs to address limitations in its electricity infrastructure.

Additional constraints on settlement development arise from the limited financial and management capacity available to support and maintain human settlement expansion. Other major regional initiatives, such as the Namakwa SEZ, must be taken into account, as they will impact surrounding settlements and increase demand for services and bulk infrastructure. During overlapping construction phases of multiple projects, competition for skilled labour and construction materials is likely to intensify.

In this context, sustainable settlement development for the port and SEZ requires that a set of minimum prerequisites be in place before major construction begins:

- Settlement plans and housing strategies for Alexander Bay and Port Nolloth must be drafted or revised to cater for anticipated population increases linked to construction and operations, including provision for temporary construction workforces and post-construction adjustment.

- Essential bulk and connector infrastructure upgrades for water, sanitation and electricity in Alexander Bay and Port Nolloth must be identified, costed and prioritised, with clearly defined funding sources (such as national grants, provincial programmes, SEZ-related investments or developer contributions) secured before large-scale construction-phase housing is authorised.

- Social infrastructure needs (schools, clinics, policing, waste management and community facilities) associated with peak and long-term population levels must be assessed and built into municipal and sector plans, with explicit responsibilities and funding pathways.

- Measures to prevent unmanaged informal settlement expansion in smaller towns, and to conserve local heritage and cultural landscapes, must be incorporated into municipal settlement and land-use planning strategies.

- For sustainable on-site construction housing and services: where projects intend to accommodate construction workers on or adjacent to project sites, worker housing must be designed to limit resource consumption and associated risks, using environmentally sensitive, sustainable building approaches, alternative technologies, grey-water reuse and, where possible, on-site renewable energy generation. Housing needs and the related demand for services must be evaluated in each project-level EIA, and any dependence on municipal services must be explicitly detailed in project design and backed by formal agreements with the relevant municipalities.

6.5.6 These measures respond directly to the challenges outlined in this chapter and acknowledge that sustainable settlement development in the core area relies on upfront or parallel investment in bulk and social services, rather than reactive interventions once major project construction is already in progress.Pressure on roads for transportation of materials, equipment and freight

Multiple green hydrogen related initiatives including the port, SEZ, pipelines, renewable energy projects and transmission infrastructure, will substantially increase the movement of materials, equipment and freight on regional and local roads, especially the R382, N7 and N14. During the development stages of the port and SEZ – and potentially also nearby green energy sites – the R382 in particular is expected to carry large volumes of heavy vehicles (see Sections 6.3.3.1). If not managed proactively, this could accelerate road wear, heighten accident risks, increase dust and noise, and place additional pressure on emergency and health services in towns such as Steinkopf and Port Nolloth. To address these pressures, the following conditions should guide project approval and roll-out:

- A coordinated freight and construction traffic management plan for Boegoebaai-related developments must be prepared, setting out expected heavy-vehicle volumes, preferred routes, construction traffic time windows and mitigation measures for settlements along the R382, N7 and N14.

- Road sections and intersections most affected by projected heavy-vehicle flows must be prioritised and included in a funded programme for road upgrading and maintenance, with clearly defined responsibilities shared between SANRAL, the provincial roads authority and municipalities.

- Road safety interventions (including traffic-calming measures, signage, law enforcement and, where necessary, bypasses or alternative access arrangements) must be designed for settlements along key freight corridors and incorporated into transport and safety plans.

- The trade-off between continued, long-term reliance on road-based freight and a greater use of rail must be explicitly assessed when considering project approvals and phasing, with explicit attention to cumulative impacts on communities and infrastructure. It is recommended that construction of the proposed rail line be prioritised much sooner, in light of the substantial impacts and risks associated with high truck volumes on regional routes, particularly on the R382.

- The siting and design of construction camps, as well as local access roads to camps, wind and solar plants, pipelines and transmission lines, must account for their proximity to settlements and be governed by conditions that minimise disturbance, dust and safety risks.

- Minimum standards should be established jointly by national regulators and the lead project proponent responsible for worker accommodation and camp management, and all major contractors must adopt formal worker-accommodation plans, apply codes of conduct to minimize tensions with local communities and vulnerable groups, and ensure that camp design explicitly accounts for potential impacts on local water, sanitation and solid-waste systems.

6.6 COLLECTIVELY, THESE MEASURES AIM TO ENSURE THAT TRANSPORT-RELATED IMPACTS ARE HANDLED WITHIN A COORDINATED REGIONAL ROAD AND FREIGHT STRATEGY, RATHER THAN BEING MANAGED ONLY ON A PROJECT-BY-PROJECT BASIS.KNOWLEDGE GAPS

A number of information and planning gaps remain relevant to the implementation of the port, SEZ and associated infrastructure. Not all gaps are of the same strategic significance. Some are material enough to influence the interpretation of this chapter's strategic conclusions and the sequencing of development, while others are more appropriately addressed through subsequent project-level studies, EIAs, detailed design and monitoring. For purposes of decision-making, the gaps identified in this chapter can be grouped into two categories

Gaps material to strategic conclusions and sequencing

These are gaps that could influence whether the development scenarios can realistically be considered strategically manageable in the short to medium term, and they should therefore be addressed as key issues before major approvals are granted and peak development phases begin. These gaps relate to:

- The availability, timing and financing of essential bulk infrastructure upgrades—especially for water, sanitation, electricity and key roads in settlements most directly affected by the port and SEZ;

- The institutional capacity of municipalities and supporting entities to process land development applications, manage cumulative settlement expansion and coordinate infrastructure planning in terms of SPLUMA and related legislation (also see section 7.6.7.1);

- Improved clarity on land access, servitude procedures and governance arrangements in areas under communal land ownership and CPA administration;

- More coherent integrated planning for the sequencing, routing and interdependence of major infrastructure components such as roads, rail, pipelines, transmission networks and renewable energy facilities; and

- A stronger evidence base on likely settlement growth or boomtown dynamics, including the magnitude and duration of construction-related in-migration and its implications for housing, social infrastructure and municipal finances.

Where these matters remain unresolved, the strategic risk profile of the Small and Large Green Hydrogen scenarios should be interpreted cautiously, and the feasibility of proceeding at scale may be reduced.

Gaps to be addressed through project-level studies, EIAs and monitoring

These gaps do not, in themselves, change the overall strategic conclusions of this chapter, but they are crucial for refining impacts, detailed design, and mitigation measures during the next stage of planning. They relate to:

- Precise route alignments and site layouts for individual infrastructure components;
- Project-specific traffic impact assessments, road safety evaluations and construction logistics planning;
- Detailed engineering analyses for bulk and connector services, including operational and maintenance needs;
- Project-specific housing, camp management and worker accommodation strategies;
- Detailed specialist studies and monitoring associated with environmental authorisation processes; and
- Project-specific social impact, emergency response and municipal services management plans.

The difference between these two categories is significant. This SEA does not demand that every uncertainty be fully resolved at the strategic level; however, some enabling conditions must be clarified to a sufficient degree before EIAs or infrastructure approvals can move forward. Specifically, the following issues should ideally be settled, or at least progressed to a stage where they are clearly fundable and implementable, before major development approvals are granted or peak construction periods commence:

- Identification of funded and sequenced bulk infrastructure upgrades for water, sanitation, electricity and key roads;
- Establishment of an operational planning support mechanism and associated municipal support arrangements;
- Agreement on land access and servitude protocols in affected areas, including communal land; and
- Preparation of coordinated settlement and service planning for Alexander Bay, Port Nolloth and other key affected settlements.

These knowledge gaps do not diminish the usefulness of the SEA; however, they show that the strategic acceptability of the proposed development pathways hinges on how well these issues are resolved in intergovernmental planning, funding, and regulatory processes.

6.7 ACKNOWLEDGEMENTS

The Authors would like to acknowledge the inputs and contributions from various officials engaged within the region as well as at the District, Provincial and National levels.

We also acknowledge several specialists operating in the private sector that contributed their expertise to provide inputs.

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Annexure A – Settlement population projections

The following table lists all settlements in the core region along with the population projections which are based on an average annual structure-based growth rate. Projections undertaken by the CSIR do not reflect the possible effects of scenarios 1 and 2, rather they reflect a baseline with continuing growth based on historic growth rates. Population projections are provided for 2030 and up to 2050. It must however be emphasised that this assumes a settlement trend based on a historic period (2015-2022).

Between 2010 and 2020 the overall population growth averaged 1.19% per annum in the Namakwa District further confirming that this region, in general, has a low overall population and settlement growth rate (Tshani Consulting, 2023, p. 53) (COGTA, 2023, p. 43)

Information discussed in Section 6.2.2 of this report.

Table A1: Settlement growth and projected population.

	Using Residential structures to determine growth[22]			Percentage change between periods		Population Projections based on Settlement growth* rate			
LM and Settlement	**Res Units 2010**	**Res Unit 2015**	**Res Units 2022**	**Perc Change 2015-2022**	**Av Per Annum change 2015-2022 (7)**	**BASE 2022**	**2025**	**2030**	**2050**
Kamiesberg LM	**5001**	**5076**	**5438**	**7.13**	**1.02**	**14970**	**15432**	**16234**	**19883**
Garies	616	622	681	9.49	1.36	3021	3146	3365	4404
Hondeklipbaai	332	332	363	9.34	1.33	803	835	892	1163
Kamassies	109	109	109	0.00	0.00	441	442	443	448
Kamieskroon	310	336	371	10.42	1.49	1437	1502	1617	2173
Karkams	651	656	660	0.61	0.09	2044	2050	2059	2095
Kheis (NC)	216	216	216	0.00	0.00	700	700	700	700
Klipfontein	306	313	325	3.83	0.55	706	718	738	823
Koingnaas*	157	165	317	92.12	13.16	164	170	177	217
Leliefontein	321	324	331	2.16	0.31	912	921	935	994
Lepelsfontein	213	215	219	1.86	0.27	320	322	326	344
Nourivier	219	222	223	0.45	0.06	673	674	676	685
Paulshoek	145	148	152	2.70	0.39	624	631	643	695
Rooifontein (NC)	180	182	183	0.55	0.08	434	435	437	444
Soebatsfontein	103	106	125	17.92	2.56	478	515	585	970
Spoegrivier	177	178	182	2.25	0.32	755	762	774	826
Tweerivier (NC)	93	93	93	0.00	0.00	351	351	351	351
Rest of Kamiesberg	853	859	888	3.38	0.48	1107	1123	1151	1267
Khâi-Ma LM	**4294**	**4414**	**5105**	**15.65**	**2.24**	**8433**	**9011**	**10065**	**15665**
Aggeneys	**648**	**661**	**862**	30.41	4.34	1377	1564	1935	4529
Onseepkans	458	470	508	8.09	1.16	1003	1038	1100	1383
Pella (NC1)	1346	1369	1396	1.97	0.28	1382	1394	1414	1495
Pofadder	973	1025	1269	23.80	3.40	2494	2757	3258	6360
Witbank	112	112	112	0.00	0.00	118	118	118	118
Rest of Khai-Ma	757	777	958	23.29	3.33	2059	2272	2676	5150
Nama Khoi LM	**19288**	**19568**	**20650**	**5.53**	**0.79**	**67204**	**68809**	**71570**	**83767**
Bersig (SPRINGBOK)	3349	3392	3409	0.50	0.07	11440	11465	11506	11672
Bullettrap	267	268	272	1.49	0.21	580	584	590	616
Carolusberg	**400**	**404**	**419**	3.71	0.53	1398	1420	1458	1621

[22] Residential structures based on GeoTerreImage data reflecting residential structures.

	Using Residential structures to determine growth[22]			Percentage change between periods		Population Projections based on Settlement growth* rate			
LM and Settlement	**Res Units 2010**	**Res Unit 2015**	**Res Units 2022**	**Perc Change 2015-2022**	**Av Per Annum change 2015-2022 (7)**	**BASE 2022**	**2025**	**2030**	**2050**
Concordia	2222	2240	2243	0.13	0.02	6959	6962	6969	6996
Goodhouse (NC)	80	80	80	0.00	0.00	233	233	233	233
Kleinzee	432	442	552	24.89	3.56	1036	1151	1371	2757
Komaggas	1227	1239	1270	2.50	0.36	4480	4528	4610	4951
Matjieskloof (SPRINGBOK)	898	902	905	0.33	0.05	2913	2917	2924	2952
Nababeep	1675	1690	1709	1.12	0.16	6758	6790	6845	7068
Nababeep Mine	122	122	122	0.00	0.00	660	660	660	660
Nama Khoi	330	334	343	2.69	0.38	582	588	600	648
Okiep	2373	2420	2439	0.79	0.11	8577	8595	8626	8751
SPRINGBOK	734	761	1160	52.43	7.49	3601	4472	6417	27208
Steinkopf	3388	3420	3571	4.42	0.63	10953	11161	11518	13061
Vioolsdrift*	171	197	422	114.21	16.32	1026	1050	1093	1279
Rest of Nama Khoi	1620	1657	1734	4.65	0.66	6008	6128	6334	7231
Richtersveld LM	**4752**	**5048**	**5667**	**12.26**	**1.75**	**24334**	25636	27961	39572
Alexander Bay*	386	502	892	77.69	11.10	4225	4451	4854	6868
Eksteenfontein	347	351	359	2.28	0.33	957	966	982	1048
Grootderm	4	20	22	10.00	1.43	477	498	534	710
Khubus	436	450	466	3.56	0.51	1779	1806	1852	2050
Lekkersing (NC)	277	283	289	2.12	0.30	669	675	685	728
Port Nolloth	2673	2714	2821	3.94	0.56	11093	11281	11602	12982
Sanddrif	**517**	**559**	**620**	10.91	1.56	3727	3904	4218	5748
Sendelingsdrif	2	51	58	13.73	1.96	655	694	765	1128
Rest of Richtersveld	110	118	140	18.64	2.66	753	814	929	1571
Grand Total	**33391**	**34162**	**36916**	**8.06**	**1.15**	**114940**	**118958**	**125967**	**158386**

Source: Calculated by authors.

'' Winsorisation applied to extreme values – applied local municipal growth rate.*

Annexure B – Gazetted Notice for Namakwa District Municipal Planning Tribunal

PROVINSIALE KOERANT, 27 JUNIE 2016 No. 2023 17

MUNICIPAL NOTICE 31 OF 2016

READINESS OF THE JOINT DISTRICT MUNICIPAL PLANNING TRIBUNAL FOR THE NAMAKWA DISTRICT MUNICIPALITY

Notice is hereby given in terms of the Spatial Planning and Land Use Management Act, 2013 (Act 16 of 2013) that the joint District Municipal Planning Tribunal (DMPT) for the Namakwa District Municipal is ready to commence its operations.

The Namakwa District Municipality and 5 Local Municipalities of the Namakwa District have entered into an agreement to establish a DMPT in terms of Section 34 of the Act.

The following members are appointed as members of the DMPT for a period of one year from the commencement of the agreement. Municipal staff members relate to specific responsibilities at the respective municipalities, of which the post designations may change over time, as well as the incumbents.

TRIBUNAL MEMBERS		
Municipal staff – Job Title	**Position**	**Municipality represented**
Head Infrastructure Head Cooperative Service Head LED/IDP	Members	Richtersveld Municipality
Municipal Manager Head Technical Service Head Cooperative service	Members	Kamiesberg Municipality
Head IDP/LED Housing Head Technical Service Head Section Head Land use and Rental Agreement	Members	Nama Khoi Municipality
Municipal Manager Senior Administrative officer	Members	Khai Ma Municipality
Municipal Manager Senior Administrative officer	Members	Karoo Hoogland Municipality
Additional Members		
C. Geldenhuys	Professional Planner	Khara Hais Municipality
J. du Plessis	Professional Planner	Khara Hais Municipality
E. Julius	Independent Member	Deptartment Economic Development and Tourism
L. Claasen	Legal Officer	Hantam Municipality
J.T. Loubser	Professional Planner	Namakwa District Municipality

Enquiries may be directed to Mr J.T. Loubser at the Namakwa District Municipality during normal office hours by telephone at 027 7128000 or in writing at the address below, or by email at info@namakwa-dm.gov.za

Mr C.J. Fortuin
Municipal manager
Private Bag X20
SPRINGBOK
8240

Annexure C - Project priority list for Water and Sanitation to address constraints

No	Municipality	Project Details	Estimated Cost (Rm)
1.	Nama Khoi	1.1 Installation of Smart Zonal Bulk Water Meters, Pressure Management with AMR functionality.	R 60m
		1.2 Installation of Smart, AMR Pre-Paid Water Meters.	R 80m
		1.3 Upgrading of Oxidation Ponds.	R 148m
2.	Khai-Ma	2.1 Pella: Construction of Bulk Water Reticulation and smart water meters	R 30m
		2.2 Development and Rehabilitation of Wastewater Treatment Facilities	R 150m
		2.3 Construction of Sewage pipelines (reticulation) - Pofadder	R 60m
3.	Richtersveld	3.1 Port Nolloth-Alexander Bay-Lekkersing Bulk Water Supply	R 180m
		3.2 Water Treatment Facilities and Solar Conversion	R 25m
		3.3 Township establishment for 2,000 stands (Boegoe Bay Harbour Project) in Port Nolloth: Township establishment, installation of bulk and reticulation services (water, sanitation, electricity, and roads)	R 342m
4.	Kamiesberg	4.1 Installation of pre-paid water meters in Kamiesberg Municipal area	R 15m
		4.2 Construction of Kharkams Bulk Sewer	R 21m

(DBSA, 2024, p. 22)

Annexure D – Priority road projects

No	Municipality	Project Details	Estimated Cost (Rm)
1.	Nama Khoi	1.1 Springbok - Upgrading of various roads and streets	R 100m
		1.2 Springbok - Upgrading of Stormwater Facilities	R 120m
		1.3 Nababeep - Upgrading of various roads and streets	R 100m
2.	Khai-Ma	2.1 Pofadder Roads Rehabilitation	R 12m
		2.2 Pella rehabilitation (heavy-duty block paving of roads)	R 15m
3.	Richtersveld	3.1 Paving of Gravel Roads - 30km	R 210m
		3.2 Rehabilitation & Maintenance of tarred roads - 47km	R 174m
		3.3 Upgrade gravel road to paving of internal gravel roads - 100km	R 285m
4.	Kamiesberg	4.1 Paving of gravel streets in Garies	R 20m
		4.2 Paving of gravel streets in Kharkams	R 10m

(DBSA, 2024, p. 25)

Annexure E – Analysis to identify potential sites for wind and solar parks.

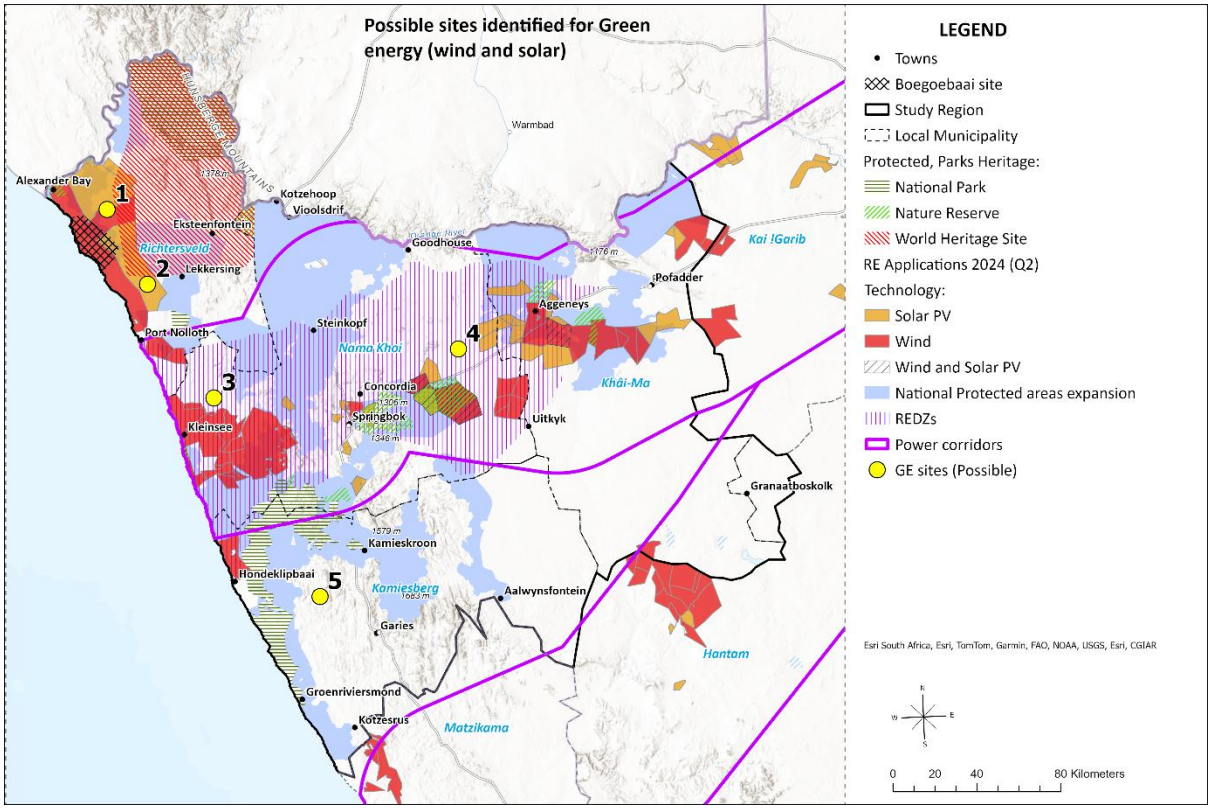

Figure F1: Sites identified for possible green energy developments

Source: (Snyman van der Walt, 2023)

Five sites have been identified through combined geospatial analysis including REIPPP projects, exclusionary factors such as nature reserves, national parks, work heritage area and national protected areas expansion. REDZ and power corridors are also featured. Five sites have been identified with potential for both wind and solar energy generation plants:

1. East of Boegoebaai
2. Between Port Nolloth and Boegoebaai
3. West of Springbok
4. North-East of Springbok
5. North-west of Garies

Annexure F – Services needed to construct the solar energy project.

Below is a list of descriptions for the types of services needed to construct the solar energy project (Soul City Solar, 2024).

MAJOR CONTRACTORS

- **Engineering, Procurement, and Construction (EPC) Contractor** (Like a General Contractor) – Leads the project, safety, and schedule. Manages all subcontractors.
- **Civil/Site Contractor** – Responsible for building roads and grading around module installation.
- **Mechanical / Structural Contractor** – Responsible for driving steel pile foundations, installing tracker/racking system, and installing modules.
- **Electrical Contractor(s)** – Responsible for building the substation, transmission line, underground collection lines between inverter skids, and wiring of the modules.
- **Substation Contractor –** Responsible for the design and construction of the substation including sitework, grading, foundation, and high voltage equipment install.
- **MAJOR Original Equipment Manufacturers (OEM)**
- **Module Supplier** – Responsible for providing site PV modules and coordinating delivery logistics.
- **Tracker / Racking Supplier** – Responsible for providing project tracker / racking system and commissioning motors and moving parts.
- **Inverter Supplier –** Responsible for providing the project inverter skids and start-up of inverters during commissioning.
- **Main Power Transformer Supplier** – Responsible for providing the project MPT(s), dress out, and start-up of MPT(s).

JOBS

Laborers

- Skilled – Skilled labour refers to labour that requires workers who have specialized training or a learned skill-set to perform the work. Activities include fencing, Stormwater Pollution Prevention Plans (SWPPP) installation and maintenance, drain tile repairs, grass and pollinator seeding, vegetative screening, and site security.
- Unskilled – Unskilled labour does not require workers to have special training or skills. Activities include waste management, portable restroom maintenance, and traffic control/flagging.

Civil

- Carpenters – Concrete form work, stairs, decking (for office trailers).
- Surveyors – Site grading and pile layout
- Concrete Finishers – Substation foundation finishing work

- Rod Busters – Tie rebar for substation foundation pours.

- Equipment Operators – Pile drivers, track hoes, bull dozers, motor graders/scrapers, back hoes, track/rubber tire loaders, skid steers, etc.

Mechanical

- Tracker Installer – Assemble and install trackers and racking system based on OEM provided manuals and specs.

- Module Installer – Offload and install PV modules

- Riggers – Align, level, and anchor machinery. Attach loads to rigging to provide support or prepare them for moving, using hand and power tools. Attach pulleys and blocks to fixed overhead structures such as beams, ceilings, and gin pole booms, using bolts and clamps.

Electricians – Read blueprints or technical diagrams. Install and maintain wiring, control, and lighting systems. Inspect electrical components, such as transformers and circuit breakers. Identify electrical problems with a variety of testing devices.

Project Manager – To plan, budget, oversee, and document all aspects of the specific project.

Superintendent – Trade specific – shall be responsible for scheduling, inspections, quality control, and job site safety.

On-Site QA/QC Managers – Inspect, test, and sample materials or assembled parts or products for defects and deviations from specifications.

- Electrical QA/QC Inspectors

- Multi-disciplined QA/QC inspectors

Site Safety Personnel – Ensures that construction workers are following established policies and safety regulations.

Site Project Scheduler – Organize, implement, and maintain scheduling management system supporting identified projects and their plans. Assist to set up tasks and sub-tasks to ensure satisfactory realization of project contract requirements as scheduled.

Craftworkers – On-site creation or reproduction of objects using a variety of techniques.

Post Construction – Operational and Maintenance Jobs

- Facilities Manager – Oversee the daily operations of solar farms. Responsible for ensuring staff are maintaining and operating the equipment and that the solar farm is producing energy as expected.
- Assistant Facilities Manger – Provide technical and sub-contractor support to the Facility Manager for the operations and maintenance of a solar farm. This includes managing the facility's sub-contractors, site maintenance and operation, training, equipment testing, and responding to emergencies.
- Inverter Technician – Responds to inverter faults and outages, supports facility team in maintaining the solar farm operations.
- Remote Operating Control Centre – Monitors and helps control the operation of the solar facility.

MINORITY CONTRACTORS AND MATERIALS SERVICES

- Surveying – As-builts, ALTA survey, road and steel pile layout
- Sanitary Facilities – Port-O-Potty, temporary trailer hook-up
- Road aggregate
- Utility fibre optic cables – Provides internet access for facility
- Trucking – Stone hauling, equipment hauling
- Pipe – PVC, steel, drain tile repair, irrigation repair
- Fuel – Off/On road diesel, gasoline
- Concrete – Off-Site
- Cement stabilization
- Water
- Ice
- Office trailers
- Office supplies
- Electrical service
- Phone/Internet service
- Paving
- Construction material testing
- Engineering services
- Drilling contractors – Substation piers
- Boring contractor – Road and pipe bores
- Dewatering
- Equipment rentals – Lights, generators, tools, equipment
- Trenching

Annexure G – Typical Activities in Powerline Construction

- Erection of camp sites for the Contractor's workforce.
- Servitude gate installation to facilitate access to the servitude.
- Vegetation clearing to facilitate access, construction and the safe operation of the line.
- Establishing of access roads on the servitude where required
- Pegging of tower positions for construction
- Transportation of equipment, materials and personnel to site and stores.
- Installation of foundations for the towers.
- Tower assembly and erection.
- Conductor stringing and regulation.
- Transfer of the line from the Contractor for commissioning.
- Final inspection of the line, commissioning and transfer to the Grid Line and Servitude Manager for operation.
- Rehabilitation of disturbed areas.
- Signing off of all Landowners upon completion of the construction and rehabilitation.
- Transfer of the servitude by the Grid Environmental Manager.
- Operation and maintenance of the line.