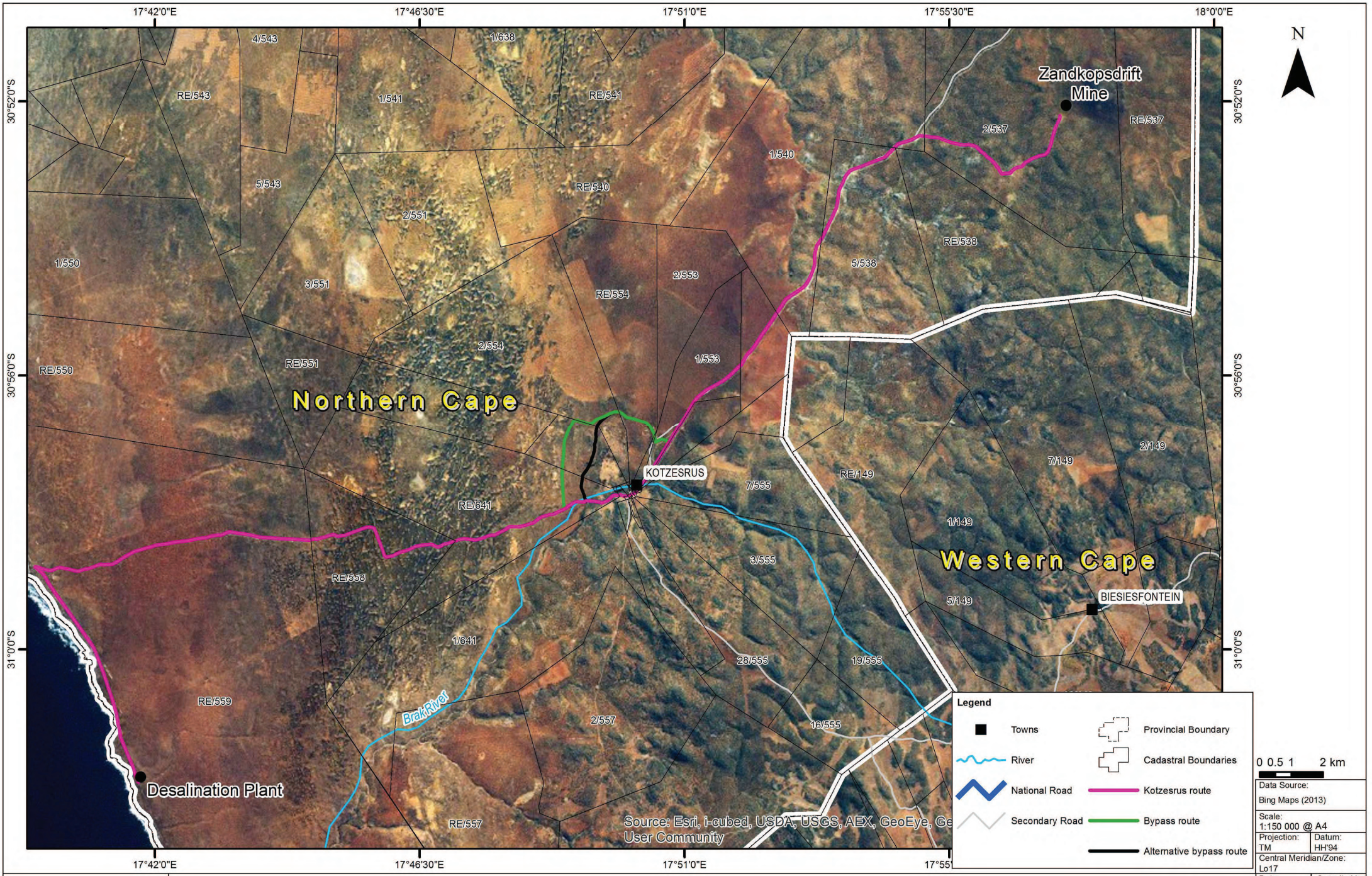

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Projection: TM	Datum: HH'94
Central Meridian/Zone:	Lo17
Date:	19 03 2013
Compiled by:	GILB/FUBM
Project No:	451101
Fig No:	3-3

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VOLWATERBAAI DESALINATION PLANT AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE

AFFECTED PROPERTIES

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Lepelsfontein

Lepelsfontein is considerably larger than Kotzesrus (approximately 465 residents), and is also remotely located. The town has a community hall and primary school (from grades 1 to 6) and water and electrical services are provided by the KLM.

Stofkraal, Molsvlei and Rietpoort

These small settlements are located to the north and east of the Zandkopsdrift Mine and as such will not be directly affected by the project.

3.4 Proponent's Project Motivation

The proposed desalination plant is the key element in the water supply scheme for the Zandkopsdrift Mine. Namaqualand is a water stressed region, situated mostly in the Orange River sub-area of the Lower Orange River Water Management Area (WMA). The area has an arid to semi-arid climate and is drought prone. There are no surface water resources such as large dams or perennial rivers in the area, and the majority of the water is obtained from groundwater resources. The estimated available groundwater yield for the Namaqualand area is 3 Mm^3/a, while the current projected regional water demand is 8 Mm^3/a. The deficit is supplied by surface water resources from the Orange and Doorn Rivers (AGES, 2013).

The proposed Zandkopsdrift Mine in the Northern Cape would have an annual water demand of approximately 4Mm^3/a. In this water scarce area, a water supply for the mine is not readily available, and Sedex Minerals has thus proposed the desalination of sea water to provide fresh water to the mine.

The design capacity of the desalination plant as well as the possible phasing and future increases in capacity (full capacity assessed in this EIA) will be determined by water demand at the mine, which is expected to increase as the mine develops.

The linear infrastructure including access roads, power supply, pipelines and water storage facilities are required to convey water from the desalination plant to the mine, and to facilitate access to and maintenance of the desalination plant and associated infrastructure.

3.5 Project Alternatives

The EIA Regulations, 2010, require that all S&EIR processes must identify and describe 'alternatives to the proposed activity that are feasible and reasonable'. Different types or categories of alternatives can be identified, e.g. location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The 'No Go' or 'No Project' alternative must also be considered.

Not all categories of alternatives are applicable to all projects. However, the consideration of alternatives is inherent in the detailed design and the identification of mitigation measures, and therefore, although not specifically assessed, alternatives have been and will be taken into account in the design and S&EIR processes.

Numerous alternatives were identified and considered during the early feasibility and design phases of the project, and are described in more detail below. In each case the identification and consideration of alternatives is briefly discussed and then summarised in a table. In each table alternatives shaded in grey are no longer considered viable options and will not be further assessed in the EIA.

3.5.1 Alternative Water Sources

Sedex Minerals identified and considered various options for water supply to the mine during early planning stages. Due to the lack of surface water resources in the area, surface water supply to the mine would not be possible, and alternative sources of water were identified. Potential groundwater sources were investigated in a series of studies undertaken by AGES between 2011 and 2013. These studies investigated (i) the three main aquifer systems in the Namaqualand region (fractured bedrock, regolith and sandy/alluvial aquifer); (ii) the deep fractured aquifers associated with regional fault zones potentially at a depth exceeding 200m; (iii) palaeo deep river channels that could be up to 40m deep; and (iv) the carbonatite plug which is proposed for mining.

These studies found that groundwater quality in the area is poor and not suitable for human consumption; in addition to which the groundwater yield would not be sufficient to support the mine's water demand. Groundwater could however be used for construction and as backup supply if the desalination plant undergoes maintenance or experiences problems. (AGES, 2013)

Seawater desalination is thus considered the only feasible option for a secure and reliable permanent water supply to the mine and Sedex Minerals established Sedex Desalination to develop the required desalination facility. The alternative sources of water considered are summarised in Table 3-2 below.

Table 3-2: Alternative Water Sources

No.	Description	Status	Considerations
WS1	Surface Water Supply	Eliminated	• Insufficient capacity, with no large dams or rivers in the area.
WS2	Groundwater Abstraction	Eliminated	• Insufficient capacity to meet the mine's water demand. • Possibility of supplementing water from desalination plant with groundwater may be considered in future.
WS3	Seawater desalination	Assess in EIA	• Considered the only feasible option

3.5.2 Location of Desalination Plant and Seawater Intake Alternatives

Sedex Desalination identified Farm Strandfontein 559 as the only farm close to the Zandkopsdrift Mine which had access to the coast and was available for sale[7]. The coastline on this property was thus investigated for suitable locations for the desalination plant, which was largely dependent on the identification of suitable location for a seawater intake to feed the desalination plant.

3.5.2.1 Seawater Intake Alternatives

During initial investigations of potential sources of raw seawater for the desalination plant, it was envisaged that seawater could be abstracted from **beach wells**. This abstraction method, if feasible, typically has a smaller impact on the environment and is more cost effective in terms of installation and operation than an open water intake. The main technical advantage of a beach well system is that abstracted seawater is pre-filtered through the sand, limiting the ingress and growth of marine organisms. Marine growth requires more maintenance, increasing operational costs (WSP, 2012)

An area near Abraham Villiers Bay (on the coast of Farm Strandfontein 559) was identified and a southern beach section of approximately 3km and a northern beach section of approximately 0.8km were investigated for beach wells. A resistivity survey was conducted in these areas to determine the thickness of saturated sand above the bedrock. Water-jet probing was also undertaken to verify

[7] The sale of this property to Sedex Desalination was concluded on 15 August 2012.

and supplement the results of the resistivity survey. Two possible beach well designs were also identified and considered:

- **Vertical beach wells**, typically installed along a section of beach in a similar manner to boreholes; and
- **Horizontal or radial collector beach wells**, in which perforated pipes are installed in a horizontal radial pattern from a central collector well.

Shallow bedrock depth rendered conditions unsuitable for both systems and beach wells were thus eliminated as a viable option for seawater abstraction. (WSP, 2012b) The decision was thus taken to proceed with the investigation of a small scale open water intake, which is considered the only feasible option.

Table 3-3: Alternative Seawater Intake Technologies

No.	Description	Status	Considerations
IT1	Intake via **beach wells**	Eliminated	• Beaches investigated had insufficient saturated sand cover to host beach wells.
IT2	**Open water intake**	Assess in EIA	• Considered the only feasible option

3.5.2.2 Alternative Locations for Seawater Intake

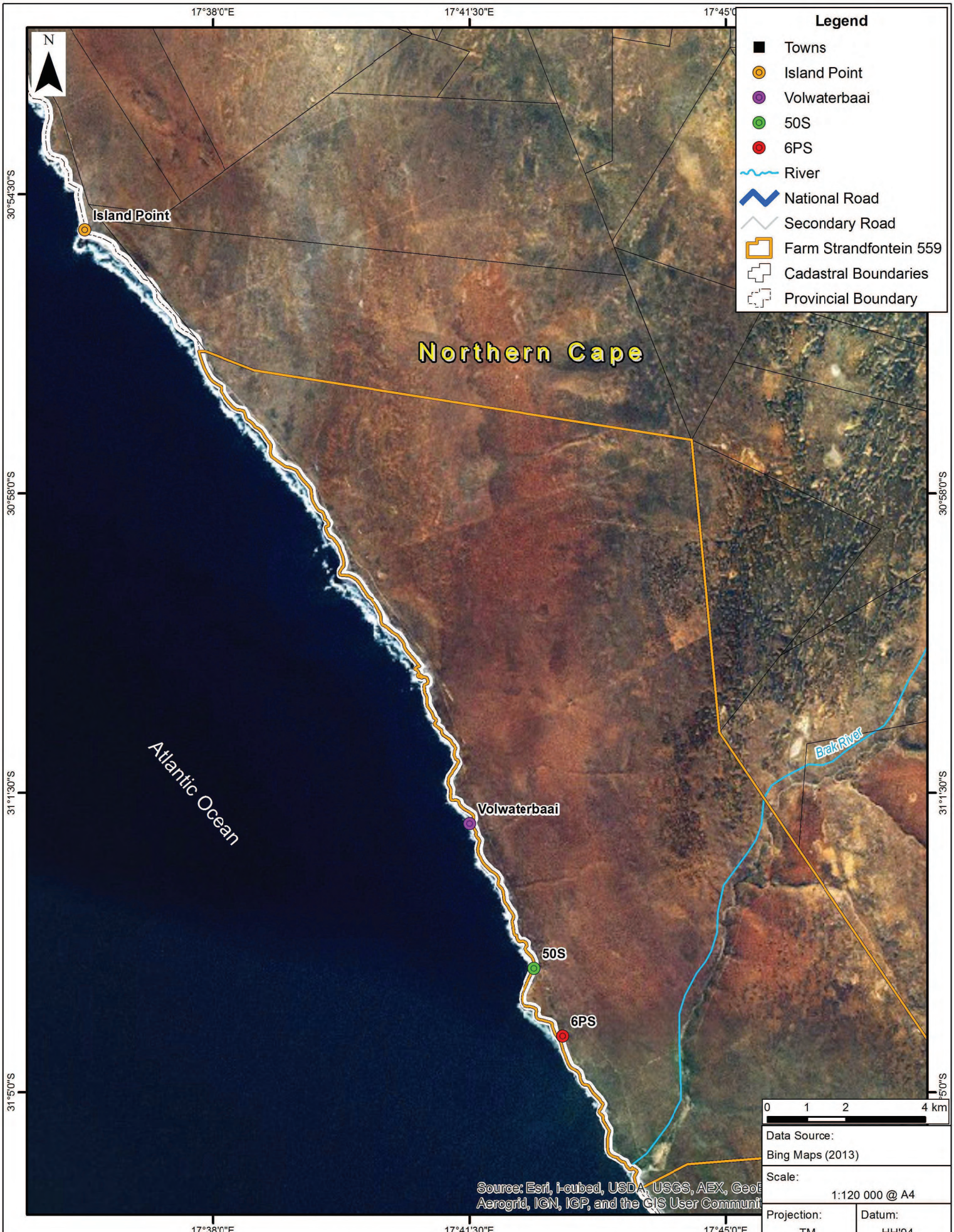
The coastline in the area features a dynamic high energy wave environment, with no significant receptors. As such finding a suitable brine discharge point was considered less difficult than finding a suitable seawater intake. Consequently priority was given to the latter on the assumption that a suitable discharge point near the seawater intake could be identified.

WSP Africa Coastal Engineers (WSP) identified 26 potential intake locations along a 28km stretch of the coastline between Island Point and south of the Brak River mouth. This list was reduced to 11 sites following a desktop review, and two additional locations were also identified during the first site visit by WSP.

Following more detailed site investigations, four sites were shortlisted, *viz*. **Island Point**, **Sunset Cruise** (now referred to as **Volwaterbaai**), **50S** and **6PS**, as indicated in Figure 3-4. In selecting potential sites, emphasis was placed on locating a site with natural features which could be exploited to provide a suitable intake solution, i.e. minimising intrusive engineering solutions. The four shortlisted sites are located at or within features that create natural gullies or channels to the shore.

The four shortlisted sites were evaluated against a common set of criteria, based on the requirements for establishing a successful seawater intake. Criteria considered include:

- Marine conditions, including protection from waves, water depth, presence of sand and suspended solids, aeration and the presence of kelp;
- Land side characteristics, including intake arrangement and suction pipework, available space for intake pump station and screening facilities, factors affecting the intake pumps station elevation and proximity to sites suitable for the location of the desalination plant;
- Constructability, considering accessibility, rock excavation required and construction requirements (above and below water);
- Brine outfall options, considering suitability, dispersion (and avoiding recirculation), distance to suitable discharge points from desalination plant and constructability; and
- Operational and maintenance issues, including power consumption and the intensity and frequency of maintenance.



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Projection: TM | Datum: HH'94

Central Meridian/Zone: LO17

Date: 19/03/2013 | Compiled by: GILB/FUBM

Project No. 451101 | Fig No. 3-4

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VOLWATERBAAI DESALINATION PLANT AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE

ALTERNATIVE LOCATIONS FOR SEAWATER INTAKE

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