PROPOSED REVERSE OSMOSIS PLANT FOR THE TRANSNET IRON ORE HANDLING FACILITY, SALDANHA: BOTANICAL ASSESSMENT

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EXECUTIVE SUMMARY

Transnet is investigating the construction of a Reverse Osmosis Plant for its expanded Iron Ore Handling Facility at Saldanha. Three Alternative sites have been proposed and are being subjected to a Basic Assessment. A botanical study was undertaken to establish impacts and mitigation measures for each site.

The flora and vegetation of the general study area has been found to be rare and sensitive, particularly for the primary dune system on the coast. These dunes also act as a sand reservoir and buffer the coast against erosion and high-energy storm events. Several rare plant species occur in the dunes and a number are endemic to the habitat and area.

Alternative 1 is located in the sensitive primary dunes and would result in the net and in the estimated permanent loss of 9 ha of dune habitat and a number of Red Data species locally. Part of the artificial salt marsh community along the edges of the reclamation dam – albeit artificial – will also be lost. The significance of the impact of such development is regarded as very high and permanent. Alternative 2 is located north and north-west of the Iron Ore Handling Facility. The RO plant would be established in an area currently containing stockpiles of gravel and construction rubble. Although Alternative 2 does possess some indigenous species and natural vegetation this is of a low quality and is species poor, with all species being common pioneers and having no rarity. In addition, it is cut off from the main (inland) body of parabolic dunes by a road and railwayline. This site is therefore of low botanical importance. Alternative 3 is situated on the quay itself and has no intrinsic value.

The preferred environmental option from a botanical perspective is either Alternative 2 or 3. Alternative 1 should be avoided at all costs as there is very little mitigation which can compensate for the location of this site in the primary dunes. This option is strongly opposed.

The reservoir which would hold water generated by the RO facility would be located in one of three locations, either adjacent to the existing reservoir (which would require partial excavation of the dune), next to the stockpiles and conveyors where iron ore is stockpiled or close to a borrow pit in the extreme west of the site on Transnet National Port Authority land. The proposed alternative location of the reservoir close to a borrow pit in the west of the site is supported as long as the structure, along with its associated pipelines, is constructed within disturbed land.

The local primary and stable dune systems have already been severely impacted by Transnet's past and current operations. Transnet has also shown no commitment to badly needed monitoring measures as recommended in Low & Pond (2001) and in other discussions with Transnet staff, and this aspect should be pursued with vigour.

By way of a biodiversity offset rather than mitigation *per se*, it is strongly recommended that the formation of a conservation area, which would cater for the protection of the local dune system in a way that future impacts on the system are prevented or at least minimised. This is in particular applicable to Alternative 1, but is also to be encouraged regardless of the Alternative chosen. Such a conservation area has been proposed in Low (2007) and in discussions with Transnet staff.

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GLOSSARY

Endemic	localised occurrence or distribution
Flora	the plant species of a particular area
Parabolic dunes	inland dunes generally in the shape of a hairpin, and with trailing arms running parallel to the wind direction. Generally stable and well-vegetated
Primary (embryo) dune	unstable, mobile dunes, usually found just above the high-water mark
Vegetation	plant species and their contribution to an area (cover, height)

1. INTRODUCTION AND BACKGROUND INFORMATION

Transnet Limited ("Transnet") proposes to construct a Reverse Osmosis (RO) Plant at the Port of Saldanha for the desalination of sea water. There are three alternative locations being investigated for the proposed plant (see general location in Figure 1). PDNA/SRK JV is currently undertaking the Basic Assessment for the proposed activity, and has appointed Coastec, in association with Mark Berry Environmental Consultants, to undertake the botanical specialist study. The Basic Assessment is required due to the following activities, listed in terms of the National Environmental Management Act, being applicable to the proposed development:

(i) The construction of earthmoving activities within 100 m of the high water mark;

(ii) The prevention of free movement of sand within a distance of 100 m of the high water mark, and

(iii) The removal or damaging of indigenous vegetation within a distance of 100 m inland of the high water mark.

In addition the vegetation of the area is part of a threatened habitat listed in the Biodiversity Act.

Alternative 1

This is located to the east of the Iron Ore Handling Facility, where the RO plant would be situated in the coastal dunes, with the possibility of brine discharge and seawater supply wells being located on the beach to the east of the existing reclamation dam stone revetment. The option of supply and outlet pipes is also being investigated. Sea water intake and brine discharge would be into the larger Saldanha Bay (Big Bay). No specific size is provided for the area of impact, although ten intake beach wells at 50 m apart would comprise the development on the beach.

Alternative 2

Alternative 2 is located north and north-west of the Iron Ore Handling Facility. The RO plant would be established in an area currently containing stockpiles of gravel and construction rubble. Due to the relatively small area of beach, both sea water supply and brine discharge wells potentially cannot be accommodated, and so beach well intakes or supply pipes with outlet pipes are being considered. Sea water intake and brine discharge would be into the smaller Saldanha Bay (Small Bay).

Alternative 3

Located on the southern section of the Quay of the Iron Ore Handling Facility, the RO plant would be positioned on a gravel area south of the Multipurpose Terminal. There is no beach in this area and sea water supply and brine discharge would need to be via pipes rather than discharge wells. Two options are proposed for this site. The first will involve intake pipes attached to the quay walls, with discharge at Caisson 3, Big Bay. The second would entail brine water intake wells either at the multi-purpose terminal or behind the stockpiles both on the quay, with discharge also at Caisson 3.

Reservoir

The reservoir(s) which would hold water generated by the RO facility would be located in one of three locations, either adjacent to the existing reservoir (which would require partial excavation of the dune), next to the stockpiles and conveyors where iron ore is stockpiled, or close to a borrow pit in the extreme west of the site on Transnet National Port Authority land. Intake and outlet pipes would be positioned along the road servicing this area.

No development Alternative

A comparison between the “no development” alternative and the proposed development has also been presented.

An initial site meeting was held on 27 June 2007 to discuss the proposed development and, in particular the proposed sites. The purpose of this meeting was to determine a coarse screening for the three Alternatives and identify any fatal flaws.

After this exercise, draft terms of reference (ToR) were drawn up for comment and finalised, together with costing, with each of the specialists.

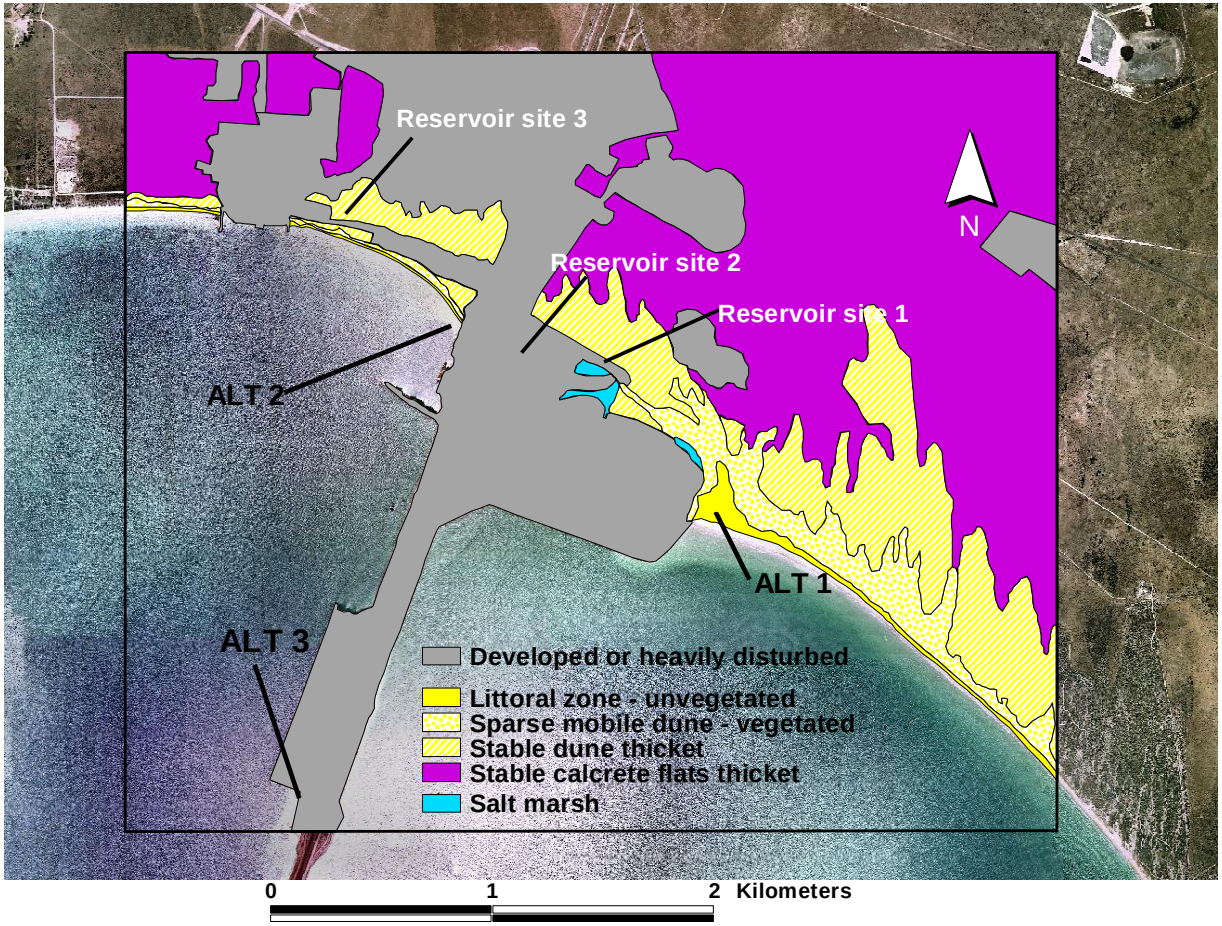

Figure 2. Transnet Ore Loading Facility: planned Reverse Osmosis Facility showing relationship of vegetation to Alternative Sites and reservoirs

2. TERMS OF REFERENCE FOR VEGETATION ASSESSMENT

The ToR for the botanical study were to:

- Attend the initial specialist site meeting and visit the three alternative sites;
- Identify any fatal flaws associated with any of the alternative sites, of the proposed project;
- Advise on design of the RO Plant early in the process;
- Based on previous specialist studies (e.g. for the Phase 1B and Phase 2 Iron Ore Terminal Upgrade EIA's), existing knowledge of the area, and additional studies where required, describe the existing vegetation and associated habitats on the sites and in the local area;
- Identify any potential endangered and/or rare/Red Data plant species and/or community/ecosystem that may be located on the sites and assess the potential impact of the establishment of the RO Plant, discussing cumulative and indirect impacts as well;
- Assess the significance of the potential impact of the proposed development on the vegetation and associated habitats for each of the alternative sites, according to the standard impact assessment methodology attached as Annexure 1 of the brief to specialists;
- Recommend mitigation measures to minimise impacts associated with the proposed RO Plant (specifying which are essential and which are optional mitigation measures);
- Indicate which of the alternative sites are environmentally suitable or unsuitable for the proposed RO Plant and identify an environmentally preferred site; and
- Prepare a report comprising both baseline information and an impact assessment.

3. METHODS AND APPROACH

The site has been visited on a number of occasions over the past six years, and has been the subject of two previous botanical investigations: Low & Pond (2001) (impact of dust) and Low (2007) (extension of ore handling capacity). In these studies a detailed assessment of the local flora and vegetation, and their regional context and importance was undertaken.

A team visit to the site was held on 27 June 2007 to discuss the three Alternatives, after which a coarse environmental screening was prepared (Table 1).

Table 1. Proposed reverse osmosis plant: coarse screening of significance of botanical impacts

Alternative Site	Loss of habitat	Loss of rare/endemic species	Loss of ecosystem function
1	High	Moderate	Extremely high
2	Low	No loss	No loss
3	No loss	No loss	No loss

The dunes which would be affected by Alternative 1 (Figure 2) were revisited on 14 July 2007 to gain a better understanding of the potential loss of habitat and ecosystem function. Subsequent to this, additional details specifying the area at Alternative 1 which would be affected was provided and the Botanist asked to provide comment on which would be a more environmentally acceptable alternative. Further, following discussions with the project team on 22 November, Alternative site 1 was reduced in order of preference when compared to sites 2 and 3 due to high environmental impacts on the beach and primary dunes, and two additional options (3C & 3D) proposed for Alternative 3.

At each Alternative Site plant species were recorded, and entered into Coastec's SaSFlora database (SaSFlora (1998 – 2007). Where present, the extent and quality of any natural vegetation was recorded, as was any aspect of ecosystem functioning. Particular attention was paid to the primary dune system at Alternative 1.

4. FINDINGS

4.1 General description of the natural environment surrounding the Transnet Ore Handling Facility

4.1.1 Vegetation

The indigenous flora and vegetation of the general area has been extracted largely from Low & Pond, 2001, and Low, 2007.

Despite negative impacts by farming, mining and *Acacia* infestation, good stands of natural vegetation still remain in the area, particularly to the north and north-east of the Transnet Iron Ore Handling Facility, in the adjacent Saldanha Steel (pers.obs.), and at Alpha Cement (Boucher and Rode, 1997).

The vegetation of the Transnet area and environs has been described and mapped by Raal (undated), in his study of the Saldanha Steel site. Three plant communities were found to occur in the area of interest. These were Limestone Shrublands, Stunted Dune Thicket and Dune Slack and Strand vegetation, after the terminology of Raal and Burns (1992). Boucher and Rode (1997) in their work on the proposed Alpha Cement project, several kilometres north and north-west of Transnet Iron Ore Handling Facility, recognise three communities which are analogous to the above. These are the *Eriocephalus racemosus* Shrubland of unstable dunes, the *Pterocelastrus tricuspidatus* Scrub of stable dunes, and the *Zygophyllum cordifolium* Shrubland of the calcareous ridges. Raal and Burns (1992) considered the Limestone Shrublands and Stunted Dune Thicket to be of high conservation importance, with Boucher and Rode (1997) concurring on the former.

“The embryo dunes and foredunes closest to the beach (i.e. the area of concern in Alternative 1) (Plates 1 to 3) are vegetated by low, creeping pioneer species which are able to tolerate sand movement, wind and salt spray. This vegetation is highly susceptible to disturbance, reflecting a temporary balance between plant cover and sand movement. It is therefore highly sensitive to any form of perturbation. The second and subsequent inland dune ridges are vegetated by dune scrub and are more stable due to higher and denser plant cover (Plates 4 to 6).

Calcrete Shrublands have been demonstrated to be of crucial conservation importance in a number of independent studies, with 9.3% of Calcrete Shrublands occurring on the Saldanha Steel site (Raal, undated). The vegetation of Saldanha is inadequately conserved (*sensu* Boucher and Rode, 1997), with the calcrete communities formally protected only in Postberg (West Coast National Park) to the south. A number of smaller nature reserves are located along the Saldanha Peninsula coastline. These include Groot Paternoster (private) and Cape Columbine (local authority). Both have a mix of vegetation on unstable and stable dunes and, to a certain extent, calcrete (pers.obs.), but lack the rare Calcrete Shrublands (Raal, undated) found in the study area and environs.

More recently the vegetation of the general area has been summarised into four broad plant communities as identified by Low & Pond (2001), all falling under a general Dune Thicket formation (*sensu* Low and Rebelo, 1996):

- Dune Thicket pioneer vegetation on embryo and foredunes (Cape Seashore Vegetation (CSV) and Langebaan Dune Strandveld (LDS))
- Dune Thicket on stable fore- and back dunes (Langebaan Dune Strandveld)
- Dwarf Dune Thicket on calcrete hills (Saldanha Flats Strandveld) (SFS))

- Dwarf Dune Thicket on calcrete flats (Saldanha Flats Strandveld).

Here analysis of plant communities clearly separated the vegetation into the various categories (Low & Pond, 2001). However, floristic similarity analysis provided a clearer picture of community differences and corroborated the findings of the vegetation analysis (Low & Pond, 2001). In the current study, it is the dune pioneer vegetation which is of greatest concern.

Table 3 provides an indication of the area occupied by each major plant community between the Transnet Ore Handling Facility and Paradise Beach. Of this area, some 48.7 ha falls within the primary dune zone (unvegetated littoral zone and sparsely vegetated mobile dunes), the area most likely to be affected if Alternative 1 is implemented.

Table 3. Extent of the different plant communities in the study area (see also Figure 2)

Plant community	Area (ha)
Littoral zone – unvegetated	9.3
Sparsely vegetated mobile dunes	39.4
Stable dune thicket	113.5
Stable calcrete flats	360.2
Salt marsh	2.4

Much of the natural vegetation has been developed or has been severely compromised by development. Langebaan Dune Strandveld (the vegetation type under which the dunes falls and which would mostly be affected by Alternative 1) is Vulnerable with 34% of its area having been transformed. Rarity for Saldanha Flats Strandveld (calcrete flats thicket) is even greater (Endangered) with some 55% of its habitat lost (Rouget et al., 2004; Mucina & Rutherford 2006). The juxtaposition of both these rare vegetation types, in essence recent dunes overlying much older calcretes - is unique (*sensu* Low & Pond, 2006) and represents a dynamic, mobile system which has great vulnerability to perturbation such as hardening of surfaces. This has major implications for the siting of the RO Plant in Alternative 1 (see below).

Flora

Species rarity of Langebaan Dune Strandveld is slightly lower than that of Saldanha Flats Strandveld with 8 out of 178 dune species (4.5%) occurring on the Saldanha Peninsula regarded as Red Data. However, dune sensitivity, in particular the primary system, is much greater than in SFS (*sensu* Low, 2006). In both these vegetation types a number of species are endemic to West Coast and even the Saldanha Peninsula calcareous dune and calcrete systems.

Of the 281 plant species recorded from 21 dune sites on the Saldanha Peninsula, 20 (7.1%) are on the Red Data list (Low, 2007). The calcrete flats flora sports 177 species (7 sites) but with proportionately a slightly lower number of Red Data species (12 – 6.8%) (Low, 2007). In both these vegetation types a number of species are endemic to West Coast calcareous dune and calcrete systems.

Locally, four Red Data species out of a total of 112 (3.6 %) are found in the dunes in the Transnet Iron Ore Handling Facility and vicinity (Low, 2007). These are: *Helichrysum cochleariforme* duineteebossie, *Euphorbia caput-medusae* subsp. *marlothiana* vingerpol (not officially recognised as a subspecies, but nevertheless a distinct form), *Afrolimon capense* Saldanha strandroos, a small shrub confined to the Saldanha Peninsula, but usually found on calcretes, and *Limonium acuminatum* a small shrub belonging to the same family as *Afrolimon*. The vygies *Drosanthemum marinum* (Langebaan to Yzerfontein) and *Lampranthus arenosus* (Saldanha Peninsula) are local dune endemics and are recorded as being are although data about their rarity status is lacking.

For the calcretes, Red Data species numbers are proportionately higher (5.8 %, or five out of 86 species). *Afrolimon capense* (locally common, in reality a calcrete endemic although occasionally moving onto dunes). *Helichrysum cochleariforme* and *Limonium acuminatum* are co-occurring species (i.e. both dunes and calcretes). The remaining two are *Helichrysum tricostatum* heuningbos and *Cephalophyllum rostellum* rotsvygie. A recent visit to the calcretes near the study area established the presence of the latter species, an endangered and endemic vygie, raising the RD numbers to six (6.9 %).

The flora of each community within the broader Saldanha area is also unique with a number of Red Data species as well as endemics (localised distribution) being found. These add to the rarity of the Transnet plant communities and the system as a whole. Additional Red Data species include *Cotula duckittiae* (buttons) (an annual daisy, and West Coast endemic, previously only known to occur as far north as Yzerfontein), and *Ixia purpureorosea*, a critically rare bulb restricted to the Saldanha area.

Based on available information (Boucher and Rode, 1997; Raal and Burns, 1992, and this study, data from SaSFlora, 1998 - 2007), the Saldanha flora restricted to calcrete and calcareous sands totals some 374 species of which 22 (5.9%) are rare. Coupled with a high level of endemism, makes this a unique flora and certainly worthy of priority conservation attention.

Floristic analysis of selected sites from the Cape Flats and West Coast (Low & Pond, 2001), indicates a progressive change in species per habitat as one moves from south to north. The Saldanha Peninsula particularly is botanically unique and emphasises the conservation importance of the area. This distinctiveness is in no small way due to the nature of the calcretes in the area, coupled with low rainfall and highly desiccating summers. This is supported by Boucher and Rode (1997) who state that the area ....."appears to be a 'hot-spot' where speciation (evolution of species) has taken place". These authors discovered some 16 rare species which were endemic, mostly all restricted to calcretes.

4.2 Alien vegetation

The dune systems and calcretes to the north and east of the site are locally infested with woody aliens, and there are several populations of *Acacia cyclops* Rooikrans adjacent to the Alternative 1 site. This species, along with *Acacia saligna* Port Jackson willow, invades sparsely to non-vegetated dunes and occasional openings in calcrete flats vegetation, either where these are naturally bare or where clearing has taken place. In the area abutting the Ore-Handling Facility dense, but localised alien invasion is due largely to disturbance caused by Transnet's operations.

4.3 Dune systems

Unique to this stretch of coastline is a north/north-west-trending parabolic dune system (Figure 2) which overrides an older, 12 m above sea level Late Pliocene (3.8 million years ago (mya) and younger), marine platform (Hendey, 1983). Dunes along the Saldanha Bay coast are from the Quaternary (1.7 mya to present) with older inland structures fixed (i.e. vegetated). Vertebrate

fossils found at Skurweweg, east of the study site, are of early Pleistocene age (1.7 mya) (Hendey, 1983).

Dunes form a crucial barrier between the coast and communities inland. Their value is varied and includes the following (after Tinley, 1985; Anon, 1991) (in Daines & Low, 1993):

- provide the coast with a protective buffer against storm seas and high spring tides thus protecting development
- act as natural sand traps, preventing beach erosion
- have an extremely high aesthetic value
- are important outdoor classrooms for environmental education
- contain important archaeological sites
- are palaeoenvironmental markers (e.g. historic sea levels) recording changes in climate and sea levels
- are unique mobile geological landforms
- represent unique ecosystem types containing rare and endemic plants, animals and biotic communities
- form an intrinsic part of the coastal environment, which is the greatest free recreation amenity in the country
- are an important source of potable water (in the form of aquifers), sand and minerals
- are an important subsistence resource for rural people in the form of plants and animals, and traditional medicines.

Although the dynamic relationship between mobile sands at the coast and stable dunes further inland is maintained in equilibrium, this relationship responds negatively to disturbances such as construction in the primary dune system and clearing of natural vegetation, both which have occurred in the area.

Coupled with this is the loss of dune function, much of which has been compromised to date due to the construction of the present iron ore handling facility where previously there would have been a primary (embryo) and stable (parabolic) dune complex. This system is clearly visible to the east of the facility (Figure 2) and stretches all the way to Paradise Beach, the next major development along this coastline. The primary dunes are critical for the supply of sand which is transported inland to form the higher and more stable fore and parabolic dunes.

The diagrams appearing in Figure 3 indicate the sensitivity of the primary dune system and indicate development should occur away from this zone. Essentially development is not advocated in this zone, the location for the Alternative 1 site.

Ideally, no development should occur in the littoral active zone, on the primary (embryo) dunes or on the foredunes. Development should be restricted to the backdune areas where there is less danger of destabilising the dunes. This would not be the case for Alternative 1. Even if the RO Plant building were to be constructed some distance away from the high-water mark, the well points would still be located in the highly sensitive embryo dune zone.

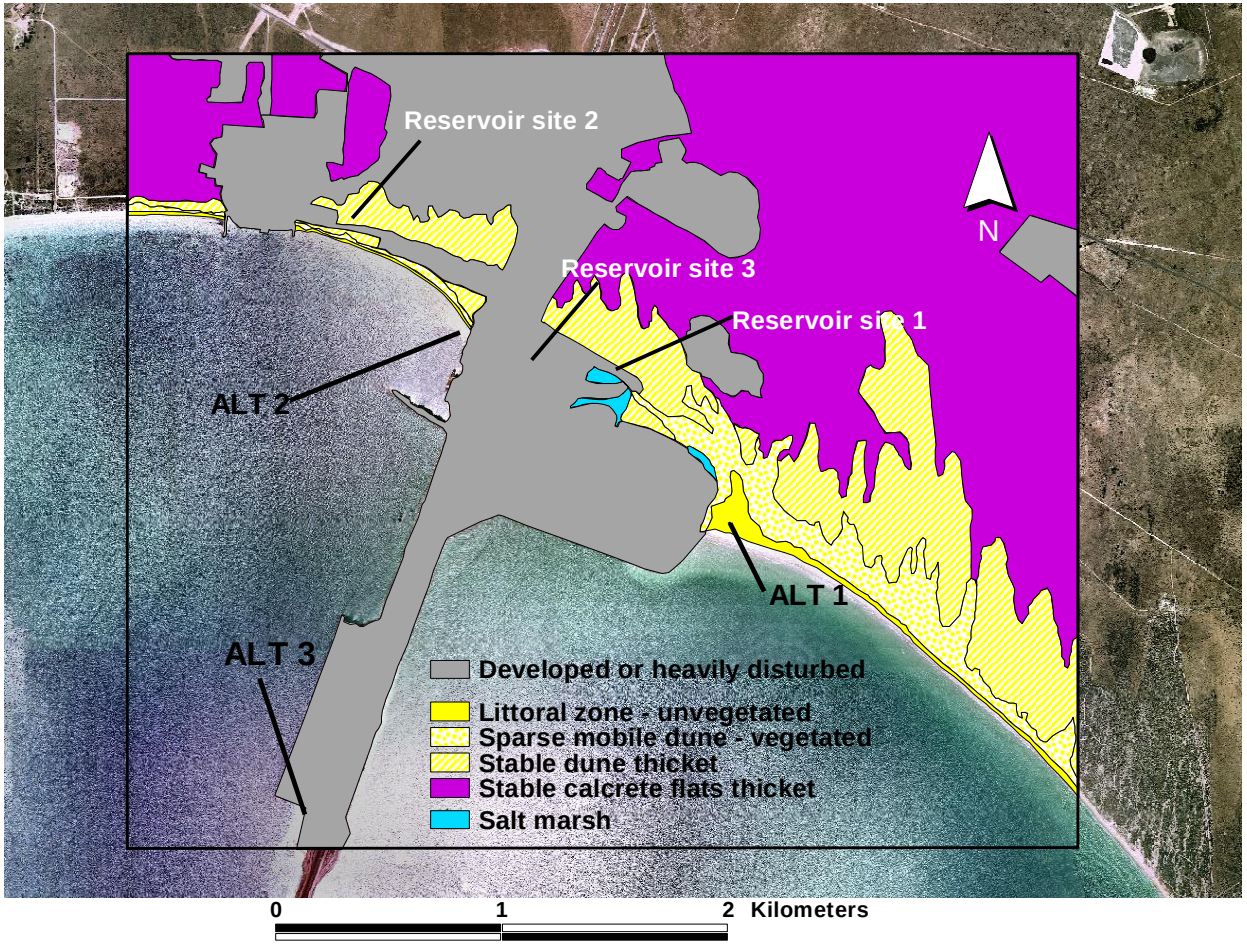

Figure 2. Transnet Ore Loading Facility: planned Reverse Osmosis Facility showing relationship of vegetation to Alternative Sites and reservoirs

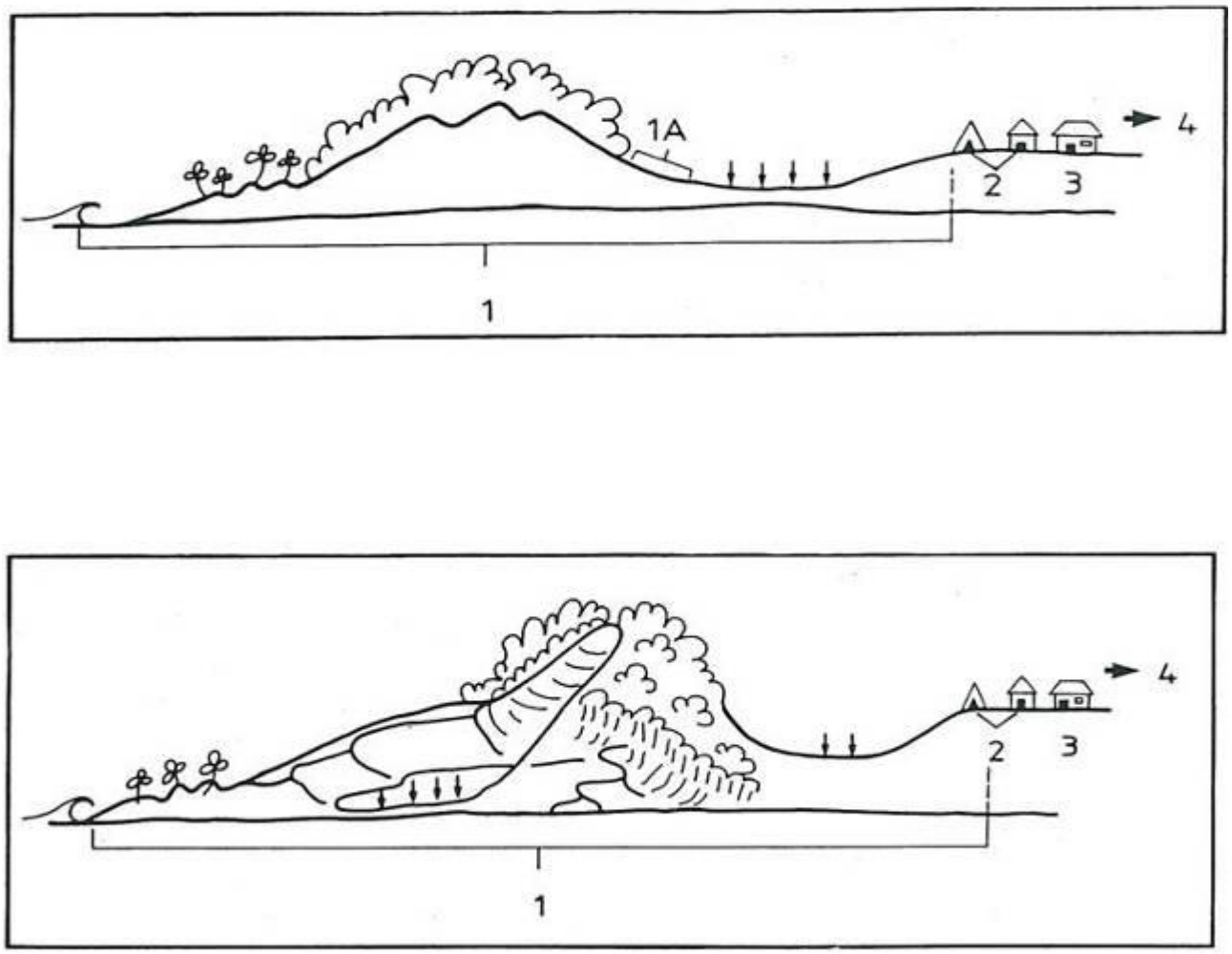

Figure 3. Schematic representation of land use guidelines for semi-stable foredunes (top) and stable parabolics (bottom), after Tinley (1985) and Daines & Low (1993). 1 – unstable dunes; 2 – low key development (camping, etc.); 3 – formal urban development; 4 – high rise buildings/ city centre

4.4 Alternative Sites

4.4.1 Alternative 1

Most of this site (Figure 2) is located in the primary dunes to the east of the existing Ore-Handling Facility, specifically east and north-east of the of present reclamation dam. Discussions with Transnet indicate the RO Plant is planned to extend over some 600 to 700 m, if both the plant as well as ten beach wells (separated from each other by 50 m) are considered. Plant species in the pioneer dune community number 34 (after Low & Pond, 2000, and Low, 2007) and include *Tetragonia decumbens* kinkelbossie, *Dasispermum suffruticosum* duineseldery, *Arctotheca populifolia* sea pumpkin, *Didelta carnosa* subsp. *tomentosa* kusslaaibos, *Senecio elegans* wild cineraria, *Cladoraphis cyperoides* steekriet and *Hebenstretia cordata* kusslakblom. None of these species is endemic to the Saldanha Peninsula region, although one – *Helichrysum cochleariforme* duineteebossie kusduinevygie - is on the current Red Data list. This is the most sensitive part of a dune system, with high sand mobility and low stability linked with low plant cover and species numbers (the fore dunes here support some 74 species – SaSFlora, 1998 – 2007). High dune mobility may also mean plant species are not permanently located in a particular area, with resultant shifts in specific species complements along the embryo dune zone. Part of the site was disturbed in the past, chiefly through bulldozing and the construction of the reclamation dam (Hart, 2007), the primary dunes in the east are in fairly good condition. This has had little consequence to the findings as the system is very mobile and windblown sand would cover up the effects of such disturbance in a short space of time.

Although the vegetation type here is Cape Seashore Vegetation (Mucina & Rutherford, 2006), this is conceptually inaccurate as both primary and inland stable dune (Langebaan Dune Strandveld, Mucina & Rutherford, 2006) vegetation are regarded as being of the same type (Low & Rebelo, 1998). 34% of Langebaan Dune Strandveld has been transformed (Rouget et al., 2004; Mucina & Rutherford, 2006), giving this vegetation type a rarity rating of Vulnerable.

Part of the artificial salt marsh community along the edges of the reclamation dam (Plate 7) is also likely to be impacted.

4.4.2 Alternative 2

Located at the interface between the start of the quay and the north-east corner of the smaller bay near Saldanha, the site has been separated from the main dune system to the north by a road and railway line (Figure 2). The vegetation here has been severely perturbated, with only a few pioneer species remaining, including *Chrysanthemoides incana* bietou and *Tetragonia decumbens* kinkelbossie. The functioning of the primary dune system has also been lost as it has effectively been cut off from the parabolics to the north by both the road and the railwayline.

4.4.3 Alternative 3

This Site is located on the southern part of the quay and is entirely manmade. It therefore has neither indigenous species nor vegetation.

4.5 Reservoir

The siting of the primary reservoir site presents no problems but should be placed as close to the existing fenceline abutting the Ore Handling Facility as possible. The alternative site to the west of the quay also presents no problems as long it is contained close to the borrow pit area on Transnet National Port Authority land. The third option lies on existing infrastructure in the terminal and poses no problem botanically. It would be desirable to retain the

parabolic dunes to the north of the pit although these have become separated from the coastal primary dunes by a road and railway.

4.6 No development option

The “no development” option would leave the primary sensitive dune zone in Alternative 1 untouched, and therefore remove the severe impacts of a loss of species, habitat and ecosystem functioning.

4.7 Conservation importance of the Saldanha region

The conservation importance of the Saldanha Peninsula plant life, particularly the calcrete flats, has been recognised as extremely high (Low and Pond (2001). The combination of this vegetation type with that of the coastal dunes (Saldanha Flats Strandveld (Mucina & Rutherford, 2006)) has a high conservation importance (Low & Pond, 2001; Low, 2007), at a local, regional and national level. Because of its susceptibility to disturbance, the dune system is also rated high for vulnerability.

Floristic analysis of selected dune sites from the Cape Flats and West Coast (Low & Pond, 2001), indicates a progressive species turnover from south to north. The Saldanha Peninsula particularly is botanically unique and emphasises the conservation importance of the area, where both the primary and stable dunes sport their own floristic character (Low & Pond, 2001). Boucher and Rode (1997) maintain that the (Saldanha Peninsula).....”appears to be a ‘hot-spot’ where speciation (evolution of species) has taken place”.

5. ENVIRONMENTAL IMPACTS OF PROPOSED REVERSE OSMOSIS PLANT

Only **Alternative 1** would suffer major impacts if a RO Plant were to be constructed in the primary dune zone. Firstly loss of primary dune habitat, i.e. between the high water mark and the semi-stable foredunes would occur. Some 48.7 ha falls within the primary dune zone (unvegetated littoral zone and sparsely vegetated mobile dunes). The area to be affected by the ten beach wells is in the order of 1.8 ha or 3.8 %. This would also result in a compromising of dune mobility and the resultant inland supply of sand to the more stable dune systems to the north, as well as the potential local loss of three Red Data species primary dune habitat and several dune endemic and/or rare species. These species are *Helichrysum cochleariforme* duineteebossie, *Drosanthemum marinum* krakervy and *Lampranthus arenosus.*

Another critical issue is that of management. Any development in the primary dune zone would open itself to ongoing and intensive control of mobile sand, in general to the detriment of the natural systems further inland. For example, windblown sand would need to be constantly removed to prevent too thick a layer accumulating above the well point covers, thus compromising the amount of sand available for transport inland. The RO Plant, too, would need to be protected from windblown sand. Personal observation of roads and buildings in the primary zone along the False Bay coast (pump station at Monwabisi, Monwabisi itself and approach road, and Baden Powell Drive), indicates management interventions are high and no doubt costly.

Negative impacts on the artificial salt marsh community (Plate 7) would occur if the RO Plant were to be constructed in close proximity. These would take the form of loss of habitat and possible compromising of the buffer area between the marsh and the primary dunes.

Impacts at **Alternative 2** (Plate 8) will be minimal in that indigenous plants colonising the site (i.e. chiefly *Chrysanthemoides incana* bietou and *Tetragonia decumbens* kinkelbossie) have invaded a disturbed environment. In addition the site has been permanently separated from the stable parabolic dunes further inland and the system has thus been irrevocably damaged. A positive impact could be the general improvement of the local environment, for example through planting of appropriate species (see below).

There are no indigenous species or natural habitats at **Alternative 3** and this is not considered an issue in the assessment, even with the consideration of possible intake along the stockpiles and discharge at caisson 3, or intake at the multi purpose terminal and pipe discharge into Big Bay via caisson 3.

Location of the reservoir in the disturbed area along the north-eastern boundary of the Ore Handling Facility would produce little impact, but would need to be sited as close to the fenceline as possible. Likewise the alternative reservoir position, in the borrow pit in the west of the site, holds no problems as long as the parabolic dunes to the north are not impacted.

Table 2. Assessment of impacts

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Alternative 1 (primary dunes east of existing facility)								
Loss of dune vegetation								
Without mitigation	Local 1	High 3	Long-term 3	High 7	Definite	Very high	-ve	High
With mitigation[1]	Local 1	High 3	Long term 3	High 7	Definite	Very high	-ve	High
Impact of local biodiversity and Red Data species								
Without mitigation	Local 1	High 3	Long-term 3	High 7	Definite	High	-ve	High
With mitigation[1]	Local 1	High 3	Long term 3	Medium 6	Definite	Medium	-ve	High
Impact on system connectivity (between the coast and inland)								
Without mitigation	Local 1	High 3	Long-term 3	Medium 6	Definite	High	-ve	High
With mitigation[1]	Local 1	High 3	Long term 3	Low 5	Definite	Medium	-ve	High

Table 2. Assessment of impacts (contd.)								
Alternative 1 (contd.)								
	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Loss of dune function								
Without mitigation	Local 1	High 3	Long-term 3	Very high 8	Definite	Very high	-ve	High
With mitigation[1]	Local 1	High 3	Long term 3	High 7	Definite	High	-ve	High
Impact on conservation status of vegetation types								
Without mitigation	Local 1	High 3	Long-term 3	High 7	Definite	High	-ve	High
With mitigation[1]	Local 1	High 3	Long term 3	Medium 6	Definite	Medium	-ve	High

Table 2. Assessment of impacts (contd.)								
	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Alternative 2 (north and north-west of the Iron Ore Handling facility)								
Without mitigation	Local 1	Medium 1	Long-term 3	Medium 5	Definite	Low	Neutral	High
With mitigation[2]	Local 1	Low 0	Long-term 3	Very low 4	Definite	None	+ve	High
Alternative 3 (on the quay)								
Without mitigation	None 0	None 0	Long-term 3	Very low 3	Definite	None	Neutral	High
With mitigation[2]	None 0	None 0	Long-term 3	Very low 3	Definite	None	Neutral	High

Table 2. Assessment of impacts (contd.)								
Reservoir and pipelines (northern fenceline)								
Without mitigation	Local 1	Medium 2	Long-term 3	Low (6)	Definite	Low	-ve	High
With mitigation[2]	Local 1	Low 1	Long-term 3	Very low (5)	Definite	None	-ve	High
Reservoir and pipelines (western site, in borrow pit)								
Without mitigation	Local 1	Low 1	Long-term 3	Very low (5)	Definite	Low	-ve	Medium
With mitigation[2]	Local 1	None 0	Long-term 3	Very low (4)	Definite	None	-ve	Medium
Reservoir and pipelines (existing terminal)								
Without mitigation	Local 1	Low 1	Long-term 3	Very low (5)	Definite	Low	-ve	Medium
With mitigation[2]	Local 1	None 0	Long-term 3	Very low (4)	Definite	None	-ve	Medium

1 Note that the mitigation to offset the impacts of a RO Plant in the primary dunes is extremely difficult, given the high sand mobility and general instability of the coastline just above the high-water mark; local loss of both habitat and ecosystem functioning will be permanent and is cumulative, given the past impacts caused by Transnet in this zone.

2 Both Alternatives 2 and 3 are on disturbed and/or developed sites and, despite the presence of a few pioneer species at Site 2, have no intrinsic botanical value

6. MITIGATION MEASURES AND RECOMMENDATIONS

Primary mitigation at Alternative site 1 would be in the form of a search and rescue operation entailing the removal of any rare or useful plants – guided by a specialist botanist - which could withstand translocation. Relocation would be to a disturbed, yet safe, area further along the coast, again guided by the specialist botanist.

In addition, and although outside of the botanical brief, those responsible for the RO plant would need to ensure there is constant management of buildings and equipment in an inherently mobile system, where sand movement would need to be maintained and appropriate species (Appendix 2) employed to provide basic plant cover in the area.

In Alternative 2, although several pioneer species are present, they have little intrinsic value as a) they are neither rare nor endemic in any way and b) this is an artificial system, having developed subsequent to construction of the Quay. Mitigation here should take the form of planting a variety of locally occurring indigenous species (see list in Appendix 2) in a manner that at least stabilises the bare and partially vegetated sand and adds some aesthetic beauty to an otherwise drab environment.

Alternative 3 has no botanical value and will not require any mitigation.

In the preferred site for the reservoir (northern fenceline), mitigation would be through ensuring the facility is kept at the greatest distance from the dune backing the track and edge of the Ore Handling Facility (i.e. as close to the fence as possible). For the second preferred location, there is no concern botanically as the site would on the existing terminal. In the 3rd Preferred location alternative site, every effort must be made to ensure the reservoir is kept to the confines of the borrow pit and does not impact on the parabolic dunes to the north; in this case no mitigation will be required, although rehabilitation of the surrounding area, particularly towards the dunes in the north, would be advisable.

Likewise, construction of any pipelines along the road linking the either reservoir site should be within presently disturbed areas, and should be rehabilitated once pipeline construction is completed.

Each of the above mitigation activities will require inclusion in a construction management plan depending on the alternative authorised.

7. CONCLUSIONS

Alternative 1 is the only site where there would be significant loss of natural habitat and significant compromising of ecosystem function. There is no mitigation which can replace a system such as this let alone offset the loss of ecosystem function. The unique combination of primary and secondary dunes traversing these ancient calcrete flats – an endemic feature of this landscape - cannot be re-created elsewhere. The primary dune environment is highly sensitive and dynamic and Transnet would be advised to avoid this site, not only because of the loss of habitat and ecosystem functioning, but also because, as pointed out above, this environment is not conducive to built structures.

Therefore, from a botanical and ecosystem perspective, Alternative 1 is not recommended because of a) the major impacts on a highly sensitive and fragile primary dune system and b) the intensive management and maintenance requirements of constructing and operating an RO Plant in this unstable environment. Alternative 3 is the preferred option, although Alternative 2 could also be considered due to past disturbance at this site and the isolation of the primary from the parabolic dunes. In addition this site does not support any rare nor endemic species.

The local dune system has already been severely impacted by Transnet's operations. Transnet has also shown no commitment to badly needed monitoring measures as recommended in Low & Pond (2001) and in other discussions with Transnet staff, and this aspect should be pursued with vigour.

An essential mitigation measure for Alternative 1 is that a biodiversity offset along the lines of that discussed in Low (2007), should be implemented as compensation for the accumulative impacts caused by Transnet over the years, as well as planned impacts for the extension of the Ore handling Facility. It is strongly recommended that the formation of a conservation area, which would cater for the protection of the local dune system in a way that future impacts on the system are prevented or at least minimised, is implemented for all of the site alternatives. Details for such a conservation area have been proposed in Low (2007) and in discussions with Transnet staff.

8. REFERENCES

Anon (1991). A policy for coastal zone management in the Republic of South Africa. Part 2. Guidelines for coastal land-use. Council for the Environment, Academica Press, Pretoria.

Boucher, C and Rode, E (1997). Alpha Saldanha Cement Project. Specialist report 2: flora. Botany Department, University of Stellenbosch, Stellenbosch.

Daines, A and Low, B (1993). Cape Metropolitan Area: West Coast environmental survey. Cape Metropolitan Council, Cape Town.

Department of Water Affairs and Forestry (2004). 1: 10 000 aerial photographs (3217DD25; 3218CC21; 3317BB5; 3318AA2, 6, 7. Department of Water Affairs and Forestry, Bellville

Hart, T (2007). Heritage impact assessment of proposed reverse osmosis plant at the Iron Ore Handling Facility, Port of Saldanha, Western Cape

Hendey, Q B (1983). Cenozoic geology and palaeogeography of the fynbos region. In "Deacon, H J, Hendey, Q B and Lambrechts, J J N (eds.). Fynbos palaeoecology: a preliminary synthesis". South African National Scientific Programmes No. 75, Pretoria.

Low, A B (2006). Environmental sensitivity and suitability study for three sites in the Khayelitsha-Mitchell's Plain urban renewal area. Coastec, Rondebosch.

Low, A B (2007). Environmental impact assessment: Phase 2 expansion of the Saldanha Iron Ore Handling Facility - botany. Coastec, Rondebosch

Low, A B and Pond, U (2001). Proposed expansion of Transnet iron ore handling facility in Saldanha: specialist vegetation study. Coastec, Rondebosch

Low, A B & Pond, U (2006). Botanical and conservation assessment of Erf 470 Laaiplek. Coastec, Rondebosch

Mucina, L, Rutherford, M C & Powrie, L (eds.) (2005). Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. South African National Biodiversity Institute, Pretoria.

Mucina, L and Rutherford, M C (eds.) (2006). The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria. Rouget, M, Reyers, B, Jonas, Z, Desmet, P, Driver, A, Maze, K, Egoh, B & Cowling, R M (2004). South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.

Raal. P (undated). Saldanha Steel Project phase 2 Environmental Impact Assessment. Specialist study of vegetation. EMATEK, CSIR, Stellenbosch.

Raal, P and Burns, M (1992). The mapping and conservation importance rating of the Cape coastal vegetation as an aid to development planning : south-western Cape coast. Report no. EMAS-C89153B, EMATEK, CSIR, Stellenbosch.

Rouget, M, Reyers, B, Jonas, Z, Desmet, P, Driver, A, Maze, K, Egoh, B & Cowling, R M (2004). South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute

SaSFlora (1998 – 2007). Site and species database for the Cape and Karoo floras. Coastec, Rondebosch

Tinley, K L (1985). Coastal dunes of South Africa. South African National Scientific Programmes Report no. 109. Pretoria, CSIR.

APPENDIX 1. PLATES OF THE STUDY AREA

Plate 1. View north-west from Alternative site 1. Note fragility of primary dune system, evidenced through bare or partially stable windblown sand

Plate 2. Alternative 1, looking north-west and west along the base of the primary/parabolic dunes system

Plate 3. *Tetragonia decumbens* kinkelbossie, a common dune builder and sand stabiliser in the primary dune zone at Alternative 1

Plate 4. Alternative site 1 viewed from the fore and parabolic dunes, well beyond the primary dune system; looking south-west. Note extent of unstable sand in mid and far distance

Plate 5. Parabolic dunes (right) traversing the ancient calcrete landscape (left)

Plate 6. Stable parabolic dunes with dense, mature dune thicket. These dunes rely on a steady supply of sand from the coast, originating in the primary dune zone. Removal of the primary dune habitat will have negative consequences for the inland dune system

Plate 7. *Juncus acutus* steekbiesie in salt marsh to the east of the Iron Ore Handling facility. Although artificially created the marsh is nevertheless a rare habitat

Plate 8. Post-development and artificial habitat, colonised primarily by the pioneer species *Chrysanthemoides incana* bietou and *Tetragonia decumbens* kinkelbossie

APPENDIX 2. PLANT SPECIES FOR USE IN REHABILITATION AT THE TRANSNET ORE HANDLING FACILITY

FAMILY	SPECIES	COMMON NAME	COMMUNITY
AIZOACEAE	Tetragonia decumbens	kinkelbossie	PD
ASPHODELACEAE	Aloe perfoliata	kransaalwyn	CF, SD
	Trachyandra divaricata	duinekool	CF, PD, SD
ASTERACEAE	Arctotheca populifolia	sea pumpkin	PD
	Chrysanthemoides incana	grysbietou	CF, PD, SD
	Didelta carnosa subsp. tomentosa	kusslaaibos	PD, SD
	Othonna cylindrica	dikblaarbobbejaankool	CF, SD
	Pteronia uncinata	strandgombos	CF, SD
	Senecio sarcoides		CF, SD
CRASSULACEAE	Cotyledon orbiculata	plakkies	SD
EBENACEAE	Euclea racemosa	seeghwarrie	CF, SD
EUPHORBIACEAE	Euphorbia burmannii	steenbokmelkbos	CF, SD
	Otholobium bracteolatum	skaapbostee	CF, SD
GERANIACEAE	Pelargonium capitatum	rose-scented pelargonium	CF, PD, SD
	Pelargonium fulgidum	rooimalva	SD
LAMIACEAE	Salvia africana-lutea	bruinsalie	CF, SD
MESEMBRYANTHEMACEAE	Amphibolia laevis	kusduinevygie	PD, SD
	Carpobrotus acinaciformis	suurvy	CF, PD, SD
	Carpobrotus edulis	suurvy	CF, PD, SD
	Jordaaniella dubia	helderkruipvygie	CF, SD
	Ruschia subpaniculata		CF, SD

PLUMBAGINACEAE	Afrolimon capense	Saldanhastrandroos	CF
	Afrolimon peregrinum	strandroos	CF, SD
POACEAE	Ehrharta calycina	rooigras	CF, PD, SD
	Ehrharta villosa	pypgras	CF, PD, SD
SCROPHULARIACEAE	Hebenstretia cordata	kusslakblom	PD
ZYGOPHYLLACEAE	Zygophyllum morgsana	slaaibos	CF, SD

PD: primary dunes

CF: calcrete flats

SD: stable dunes