



NICK HELME BOTANICAL SURVEYS

PO Box 22652 Scarborough 7975

Ph: 021 780 1420 Fax: 021 780 1868 cell: 082 82 38350 email: botaneek@iafrica.com

VAT Reg. # 4930216892

SPECIALIST BOTANICAL IMPACT ASSESSMENT FOR CITY OF CAPE TOWN BULK WATER SUPPLY INFRASTRUCTURE PLANNING STUDY

**Appointed by: *Orrie Welby-Solomon & Associates cc/BKS (Pty) Ltd* Joint
Venture**

Submitted to: Chand Environmental Consultants, Plumstead

On behalf of : City of Cape Town

30 Mar 2006, partly revised 29 Nov 2007; and again 15 Apr 2008

1. INTRODUCTION AND STUDY AREA

This botanical impact assessment was commissioned in order to help inform decisions regarding the proposed infrastructure associated with a new water treatment plant (WTP), reservoir, and bulk water pipelines for the City of Cape Town. Four alternative WTP sites were identified for scoping, but three of these were rejected during the process, and only the Joostenberg/Muldersvlei sites need to be assessed for the Impact Assessment (with three alternatives – A, B, and G.) Three main pipeline routes (aka High and Low routes, with alternatives at certain points, plus the New Preferred route for the section between Dasbos outlet and Klapmuts) are also assessed, along with access roads to WTPs and reservoirs A, B, and G.

The proposed infrastructure falls mostly within the lowland area of the Cape Metropolitan Area (CMA) and the Drakenstein Municipality (Paarl & Stellenbosch), and the natural vegetation in this area has long been identified as highly threatened and supporting numerous rare and locally endemic plant species (Jarman 1986; McDowell and Low 1990; Wood and Low 1993; Wood *et al* 1994; Maze and Rebelo 1999). The area concerned is largely north and east of the Cape Flats, this being a subset of the wider region known in botanical terms as the Cape Lowlands (being all areas under about 300masl from Piketberg to Cape Town to Albertinia). Due primarily to rapid urbanization (which includes infrastructural development), agriculture, and alien plant invasions the extent of natural vegetation on the Cape Flats and adjacent areas has declined very rapidly over the last thirty years, and many species confined to the area have now become globally rare and are listed in the Red Data Book of threatened plant species (Hilton-Taylor 1996). As an indication of the degree of threat to the Cape Flats flora, it should be noted that the Cape Flats has contributed a disproportionately large 10% of the total plant extinctions in South Africa (Wood *et al* 1994), and an even more striking figure is that a full 85% of all the threatened plants in South Africa are restricted to the Western Cape (Raimondo *et al* – in prep.)!

The main broad vegetation types found within the study area are Cape Flats Dune Strandveld (previously known as Cpe Flats Dune Thicket / Fynbos Mosaic in C.A.P.E. project), Cape Flats Sand Fynbos (previously Blackheath Sand Plain Fynbos), Swartland Alluvium Fynbos and Swartland Shale Renosterveld (previously Boland Renosterveld). Studies (Cowling *et al* 1998; Cowling and Heijnis 2001) have shown that the majority of the lowland vegetation types found within the CMA and Drakenstein Municipality are critically threatened and severely underrepresented in terms of conservation areas. The C.A.P.E. project (Cape Action for People and the Environment) is an internationally funded, innovative, objective approach to

assessing the threats to natural habitats in the Cape Floral Region (Cowling *et al* 1998), and has as one of its goals adequate broad scale conservation planning for the area. Two of the core tenets of conservation planning are the concepts of Irreplaceability (how much of the remaining natural habitat is critical in order to achieve the conservation “targets”) and Vulnerability (the degree of threat posed by factors such as urbanisation, alien plants, and agriculture). These studies have shown that most of the vegetation types on the Cape Flats (namely Cape Flats Dune Strandveld, Cape Flats Sand Fynbos, and Swartland Shale Renosterveld) have both Vulnerability and Irreplaceability values of 100%, and that all remaining examples of these natural habitats need to be conserved in order to achieve the designated conservation targets (Cowling *et al* 1998). This effectively means that no development should be allowed by the authorities within these vegetation types anywhere within the CMA, and that all these areas should be managed as conservation areas.

As the Renosterveld areas in the Swartland have been reduced to less than 4% of their original extent (Von Hase *et al* 2003) all remaining areas of this vegetation type have been recognised as 100% Irreplaceable in terms of achieving C.A.P.E. project conservation goals (Cowling & Heijnis 2001), and any developments that may impact on this vegetation type therefore need to take this into account.

The new SA vegetation map (Mucina & Rutherford 2006) uses a slightly different terminology to describe the different vegetation types. The relevant vegetation types along the route include Swartland Shale Renosterveld, Swartland Alluvium Fynbos, and Hawequas Sandstone Fynbos. Rouget *et al* (2004) assessed the conservation status of all vegetation types in the country for the National Spatial Biodiversity Assessment (NSBA), and concluded that Swartland Shale Renosterveld is Critically Endangered, whilst Swartland Alluvium Fynbos is an Endangered vegetation type. These are the two highest categories of conservation value, and are reflective of the high levels of habitat transformation in this area. Hawequas Sandstone Fynbos is relatively well conserved, and is considered Least Threatened.

2. TERMS OF REFERENCE

- Identify the impacts associated with each of the proposed pipeline routes and locations for the water treatment plants.
- Recommend mitigation measures for the minimisation of negative impacts and the maximisation of the positive impacts of the proposed bulkwater project.
- Provide a comprehensive assessment of the significance of the impacts associated with the proposed bulkwater project. The impacts associated

with all pipeline and treatment plant alternatives should be assessed, in addition to those associated with the “no development” option, which will comprise the status quo.

2.1. Definition of significance

The following definitions have been applied to the assessment.

No significance: the impacts do not influence the proposed development and/or environment in any way.

Low significance: the impacts will have a minor influence on the proposed development and/or environment. These impacts require some attention to modification of the project design where possible, or alternative mitigation.

Moderate significance: the impacts will have a moderate influence on the proposed development and/or environment. The impact can be ameliorated by a modification in the project design or implementation of effective mitigation measures.

High significance: the impacts will have a major influence on the proposed development and/or environment and will result in the “no-go” option on the development or portions of the development regardless of any mitigation measures that could be implemented. This level of significance must be well motivated.

Significance is typically at the regional scale, unless stated. In this context regional scale implies southern Swartland and Cape Metro (the main extent of the vegetation types concerned). However, the situation is complicated in that the vegetation types are restricted to a small portion of the Western Cape and thus in some respects they can be thought of as being of both national and global importance (ie. they cannot be conserved elsewhere), and thus a loss of any natural vegetation anywhere in the Western Cape will by extension also be of national and global significance. Virtually any patch of natural vegetation is actually unique in its total species composition and is thus technically Irreplaceable when one starts to consider relationships and interactions between species. Significance ratings are thus always subjective and will depend on how far one wishes to take these views. I have attempted to focus in on the significance of habitat and species loss at the regional level.

3. LIMITATIONS AND ASSUMPTIONS

No significant limitations were imposed, and the main assumption was that width of disturbance associated with a new pipeline would be between 20 and 27m in total.

4. IMPACT ASSESSMENT OF THE SENSITIVE AREAS, WITH PROPOSED MITIGATION

The bulk of the proposed development area (over 95%) supports no indigenous vegetation of any significance, due to a long history of disturbance for agriculture, forestry, and quarrying. The botanical significance of the proposed developments in these areas is **Not Significant**, and no mitigation is required.

The proposed alternatives and all sections of the pipelines that do support any indigenous vegetation are described in Helme (2005), and detailed descriptions are not repeated in this EIR. This EIR covers only the sensitive areas identified in the scoping report (Helme 2005).

Most of the natural vegetation in the study area has been mapped for the new vegetation map of South Africa (Mucina & Rutherford 2006) as Swartland Shale Renosterveld, but there are also significant areas of Swartland Alluvium Fynbos, and small elements of Hawequas Sandstone Fynbos. The former is restricted to lowland areas on shales, from Piketberg to Somerset West, and as noted in the introduction, less than 4% of this vegetation type remains, and as a result the patches that still support viable plant communities have a Very High regional conservation value, and are considered to be 100% Irreplaceable in terms of achieving conservation targets. The vegetation type is considered to be Critically Endangered in terms of the NSBA ratings (Rouget *et al* 2004). Any proposed bulk infrastructure that will impact on this vegetation type should thus be realigned.

3.1 WATER TREATMENT PLANT – ACTUAL SITE FOOTPRINTS

3.1.1 Joostenberg / Muldersvlei

This section covers the actual footprints of the proposed WTPs and their associated reservoirs, and does not cover the associated pipelines (for this see Sect. 3.3).

Joostenberg / Muldersvlei was the preferred alternative from an engineering and cost point of view, and fortunately also happens to be highly suitable from a botanical point of view, as very little natural vegetation would be impacted by any of the proposed WTP alternatives in this area. Five alternative WTP sites were identified in this area, and two were excluded, so that only A, B, and G (close to Klapmuts) remain for assessment.

The only one of the alternatives that would have any direct botanical impact is WTP A, which is located partly over a seasonal wetland on clays, which supports the sedge *Eleocharis limosa* and kweek grass (*Cynodon dactylon*). As the site was visited during the dry season the wetland was dry and there was little evidence of other species. The wetland is heavily impacted by grazing and trampling by cattle, and I suspect that few indigenous species survive in the wetland. However, there is still a very small chance of there being some rare bulbs in the area, and the site has a Low – Moderate conservation value (local scale; Low on a regional scale).

Sites B and G are both located entirely within farmlands, with no natural vegetation. From a botanical perspective there are no significant differences between the three alternative sites.

Significance ratings: A: Very Low –ve

B: None

G: None

Given that impacts are low or negligible no mitigation is proposed.

3.2 PROPOSED ACCESS ROADS

3.2.1 Site A

Pave existing gravel road: No significance.

Significance rating: None

3.2.2 Site B

As no negative botanical impacts are associated with the proposed paving of existing access roads no mitigation is proposed.

New paved roads (both alternatives): Neither road will have any botanical significance as they pass through old agricultural lands.

Paving of existing gravel roads: No significance.

Significance rating of all alternatives for this site: None

3.2.3 Site G

New paved road: No significance, as passes through disturbed agricultural areas.

Significance rating: None

3.3 PROPOSED PIPELINE ROUTES ASSOCIATED WITH EACH WTP

This section covers the site specific pipelines that feed and radiate from each of the three WTP alternatives. Thus the site specific pipelines cover fairly short distances, and run from the main new route to the WTPs, and from the WTPs to the existing Wemmershoek pipeline along the N1. Detailed figures of the three alternatives are presented (Figs. 1-3), clearly indicating sensitive areas.

3.3.1 WTP A

Four sensitive areas occur along pipeline routes associated with this area (A2 – A4 on Figure 1; point A1 is on hardcopy map only).

Point A1 : This occurs immediately west of Klappmuts, and is also on the red route (High route), south of the N1 highway. The natural vegetation in this area has been partly to heavily disturbed, and is severely invaded by alien species, but could be partly restored, and is currently of Moderate conservation value. The natural vegetation in the area is a Swartland Shale Renosterveld, which is Critically Endangered. At least one Red Data Book listed plant species occurs within the pipeline corridor (*Leucadendron corymbosum*; Near Threatened), although this population is small and not viable unless the area is specifically managed for conservation, which is clearly not currently the case. Pipeline construction will further disturb this area, and will virtually destroy the population of the Red Data Book species.

Significance rating for Area A1 (before mitigation): Moderate -ve

Mitigation

The only mitigation possible with this alignment would be to clear all invasive alien vegetation within areas of natural vegetation within 100m of the pipeline, in addition to all the usual requirements of having to return topsoil to the trench as soon as possible, minimise footprint, etc.

Significance rating within Area A1 (after mitigation): Low to Moderate -ve

Points A2 and A3: These two areas would cross the upper and lower sections of a Renosterveld drainage line, and would have a disturbing influence on the remaining natural vegetation, which may include some rare species (cannot be sure as this was

a new section and not possible to assess during summer). Assessment is together as it is the same habitat in both areas.

Significance rating for Area A2 and A3 (before mitigation): Moderate -ve

Mitigation

Mitigation should include Search and Rescue of all rare species during the winter – spring period. Further mitigation should be to clear all invasive alien vegetation within areas of natural vegetation within 100m of the pipeline, in addition to all the usual requirements of having to return topsoil to the trench as soon as possible, minimise footprint, etc.

Significance rating within Area A2 and A3 (after mitigation): Low to Moderate -ve

Point A4: This partly disturbed Renosterveld area is seasonally wet and still supports a number of bulb species (some possibly rare) and the Red Data Book listed *Athanasia capitata* (Endangered). The pipeline would significantly disturb this area.

Significance rating for Area A4 (before mitigation): High -ve

Mitigation

Mitigation should include Search and Rescue of all rare species during the winter – spring period. At least twenty plants of the rare *Athanasia capitata* (Endangered) would have to be moved. Further mitigation should be to clear all invasive alien vegetation within areas of natural vegetation within 100m of the pipeline, in addition to all the usual requirements of having to return topsoil to the trench as soon as possible, minimise footprint, etc.

Significance rating within Area A4 (after mitigation): Moderate -ve

Overall assessment of WTP A pipelines after mitigation: Moderate -ve

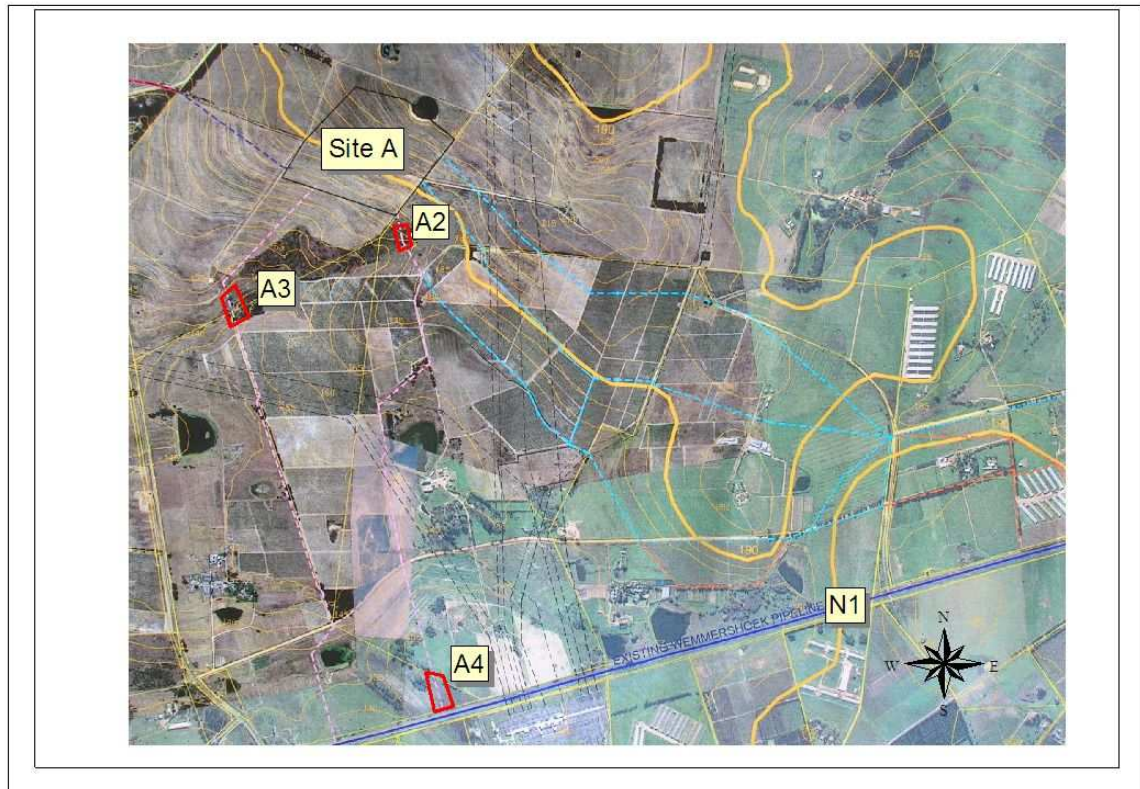


Figure 1: Map showing sensitive areas A2 to A4.

3.3.2 WTP B

WTP B shares sensitive areas with WTP A, and these will not be described again. The shared areas are B1 (hardcopy only) and B4, and mitigation is the same as for these areas. Figure 2 shows areas B2 - B4.

Significance rating for Area B1 (before mitigation): Moderate -ve

Significance rating within Area B1 (after mitigation): Low to Moderate -ve

Significance rating for Area B4 (before mitigation): Moderate -ve

Significance rating within Area B4 (after mitigation): Low to Moderate -ve

Area B2 is a large wetland area with moderate plant diversity and high ecological value (frogs, birds, etc.), and high scenic value. No rare plant species are likely to occur, but a pipeline will significantly disturb the area, and mitigation is not really possible.

Significance rating for Area B2 (before mitigation): Moderate -ve

Significance rating within Area B2 (after mitigation): Moderate -ve

Area B3 is a partly disturbed area with some large wild olive trees and the rare *Athanasia capitata* (Endangered), on seasonally wet clay soils. Mitigation is not easy and only Search and Rescue for all rare species in winter or spring can be recommended.

Significance rating for Area B3 (before mitigation): Moderate -ve

Significance rating within Area B3 (after mitigation): Low to Moderate -ve

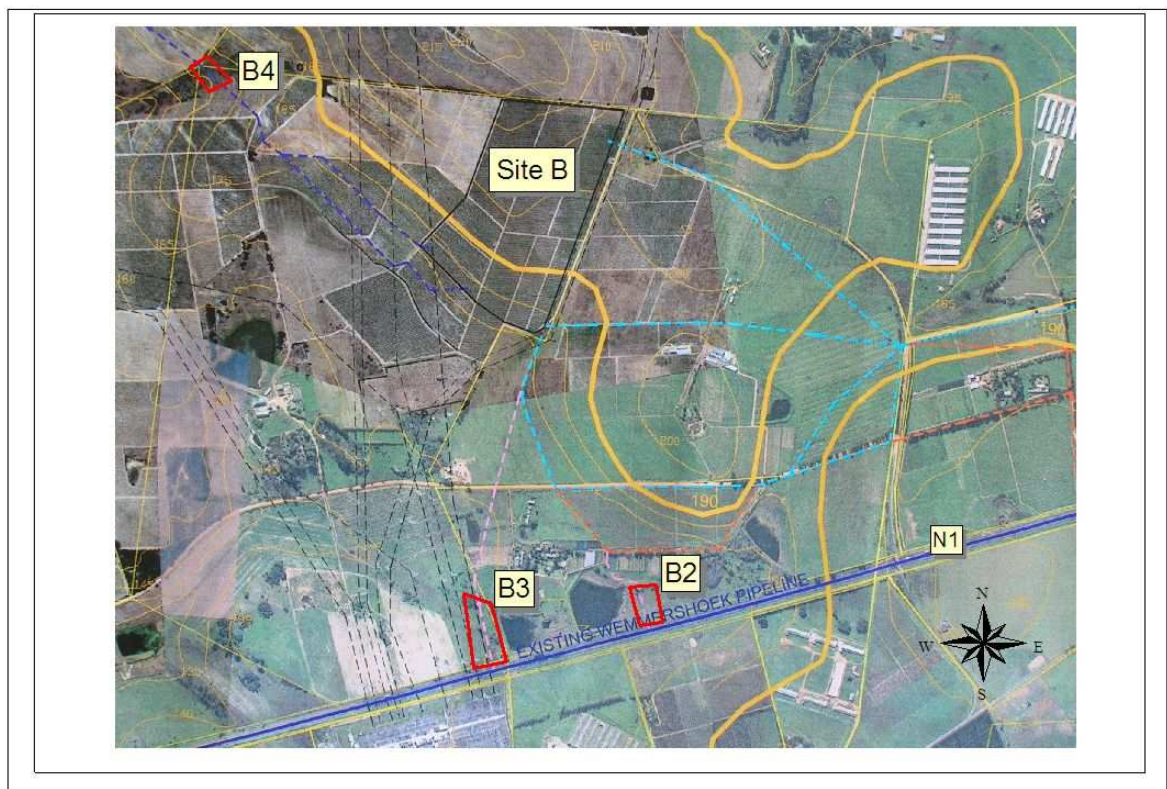


Figure 2: Map showing sensitive areas B2 to B4.

Overall assessment of WTP B pipelines after mitigation: Moderate -ve

3.3.3 WTP G

This alternative has the least number of sensitive areas, and one of them (G2) is shared with both Alternatives A and B, and will not be described again.

Significance rating for Area G2 (before mitigation): Moderate -ve

Significance rating within Area G2 (after mitigation): Low to Moderate -ve

Area G1 is short strip of pipeline that would cut across the head of the wetland between two dams. The Red Data Book listed species *Athanasia capitata* (Endangered) occurs in this area, and there is a moderate diversity of indigenous species, plus many invasive aliens. Mitigation should be to use the alternative route just to the east, which would not cross the wetland.

Significance rating for Area G1 (before mitigation): Moderate -ve

Significance rating within Area G1 (after mitigation): Low -ve



Figure 3: Map showing sensitive areas G1 and G2.

Overall assessment of WTP G pipelines after mitigation: Low -ve

WTP G is thus the preferred WTP site in terms of botanical impacts of the associated pipelines.

3.4 PROPOSED MAIN PIPELINE ROUTES

The main pipeline route runs from the Berg River Dam to the Dasbos outlet to the proposed Spes Bona reservoir, and would have to go via the WTP, wherever this is situated (alternatives A, B, or G). The following analysis follows the route from the

Skuifraam dam to Spes Bona, and areas of concern are sequentially numbered and indicated with white stickers on the A0 aerial photograph maps 1- 4 (hardcopy only).

3.5.0 Dasbos Pumpstation – Dasbos Outlet

The extant vegetation in the area is of low diversity, primarily as a result of forestry activities and a fairly long history of dense alien invasion in adjacent areas (now partly cleared).

The primary area of conservation concern along the pipeline route is the crossing of the river (about 400m east of Dasbos tunnel; **Area 1** on map 4 of 4), as this narrow, deep channel holds water for much of the year, and supports a distinct riverine plant community. The actual channel appears to be split into three, with the main one being in the west. Although botanical diversity is relatively low, this riverine area has ecological value, and disturbance needs to be minimised.

The construction of the pipeline over this section of the route would have a Low regional impact, except for the river crossing area, where this would have a Moderate negative local impact.

Significance rating outside Area 1 (before mitigation):	Low -ve
---	---------

Significance rating within Area 1 (before mitigation):	Moderate –ve
--	--------------

Mitigation

Mitigation should include:

- Clearing of all invasive aliens within 100m either side of the pipeline (already being done).
- Stockpiling and replacement of topsoil once all construction activity has ceased (standard for all areas).
- Ongoing alien removal in the area in order to deal with the soil stored seedbank.

Significance rating outside Area 1 (after mitigation):	None
--	------

Significance rating within Area 1 (after mitigation):	Moderate –ve
---	--------------

3.5.1 Dasbos outlet – Klapmuts (High & Low routes)

There are no significant areas of natural vegetation crossed by either the red (High route) or orange (Low route) standard routes on the way from Dasbos to Klapmuts. The routes cross farmland and disturbed ground, or very small patches of partially natural vegetation of Low botanical conservation value. However, the High route alternative (dashed pink line) partly crosses one significant patch of natural vegetation, about 600m wide, detailed below.

Area 2, about 800m west of Dasbos, is about 600m wide (map 4). This is a remnant patch of Swartland Alluvium Fynbos, and supports a diverse mix of species with a moderate likelihood of rare species, although none were recorded in January 2005. It is quite likely that this area will be developed for vineyards at some stage in the future, but nevertheless it currently has a High conservation value, and disturbance should be minimised if possible.

Significance rating for Area 2 (before mitigation): Low to Moderate -ve

Mitigation

The pipeline currently appears to run along the northern edge of most of Area 2, thus minimising impact on the remaining patch to the south, but will still have an impact on the natural vegetation. The only mitigation really possible with this alignment would be to clear all invasive alien vegetation within areas of natural vegetation within 100m of the pipeline.

Significance rating within Area 2 (after mitigation): Low -ve

3.5.2 Dasbos outlet – Klapmuts (New Preferred route)

This is the preferred route from engineering, social and botanical points of view and crosses no special sensitive areas. The route is in most areas a combination of the High and Low routes, and runs close to the main roads. The most sensitive areas would be about 300 – 600m north of the Dasbos outlet, but these areas still have only a Low regional conservation value.

Significance rating (before mitigation): Low -ve

Significance rating (after mitigation): Low -ve

3.5.3 Klapmuts – Joostenburg WTP

Only one short section of the alternative pipeline routes will have any significant impact on the natural vegetation in this section (Area 3). This occurs immediately west of Klapmuts, on the red route (High route), south of the N1 highway. The natural vegetation in this area has been partly to heavily disturbed, and is severely invaded by alien species, but could be partly restored, and is currently of Moderate conservation value. The natural vegetation in the area is a Swartland Shale Renosterveld, which is Critically Endangered. At least one Red Data Book listed plant species occurs within the pipeline corridor (*Leucadendron corymbosum*; Near Threatened), although this population is small and not viable unless the area is specifically managed for conservation, which is clearly not currently the case. This is thus not the preferred route for this section, as construction of the pipeline will further disturb this area, and will virtually destroy the population of the Red Data Book species.

Significance rating for Area 3 (before mitigation): Moderate -ve

Mitigation

The only mitigation really possible with this alignment would be to clear all invasive alien vegetation within areas of natural vegetation within 100m of the pipeline, in addition to all the usual requirements of having to return topsoil to the trench as soon as possible, minimise footprint, etc.

Significance rating within Area 3 (after mitigation): Low –ve

3.5.4 Joostenberg WTP – Spes Bona

Four areas (Areas 4 – 7; maps 1 of 4, and 2 of 4) of varying botanical sensitivity occur along the proposed alternative routes in this section:

- i) **Area 4** is located just south WTP Site A, and is a drainage line supporting a remnant patch of partly degraded Swartland Shale Renosterveld of High Conservation Value, and should not be disturbed. The chance of rare species occurring within the area is considered to be high. Two portions of the dotted dark blue, and two portions of the dotted pink alternatives cross this drainage line with its Renosterveld vegetation.

Significance rating of dotted blue and dotted pink alternatives for Area 4
(before mitigation): Moderate –ve

Mitigation

The only mitigation in this area that will reduce the impact significantly would be to use an alternative alignment that does not impact on this patch of Renosterveld. If this is not done additional mitigation should include minimising the extent of disturbance in this area, Search and Rescue, and clearing all aliens in the natural vegetation within 100m of the route. This is the mitigation used in the assessment below.

Significance rating of dotted blue and dotted pink alternatives for Area 4
(after mitigation): Low to Moderate –ve

ii) **Area 5** is a narrow patch (about 90m wide) of high quality Swartland Shale Renosterveld of High Conservation Value, and should not be disturbed. Only the High route alternative (solid pink) impacts on this area, where there is a good likelihood of rare species occurring.

Significance rating of High route alternative (solid pink) for Area 5
(before mitigation): Moderate –ve

Mitigation

Mitigation should ideally be the use of an alternative route that avoids this patch of Renosterveld. If this is not done the mitigation should include minimising the extent of disturbance in this area, Search and Rescue, and clearing all aliens in the natural vegetation within 100m of the route.

Significance rating of High route alternative (solid pink) for Area 5
(after mitigation): Moderate –ve

iii) **Area 6** is a crossing of a seasonal wetland in acid sands overlying shales, with degraded remnant natural vegetation mixed with a substantial number of alien invasive grasses, annuals, and trees. The river is highly eutrophic and degraded, and the indigenous wetland species include *Typha capensis* (bulrush) and *Cyperus textilis*. No rare or localised species were recorded and none is likely. This area is

crossed by the High route and its alternative (one of which is the preferred alternative).

Significance rating of High route and preferred alternative for Area 6
(before mitigation): Low –ve

Mitigation

Mitigation should include minimising the extent of disturbance in this area, Search and Rescue, and clearing all aliens in the natural vegetation within 100m of the route.

Significance rating of High route and preferred alternative for Area 6
(after mitigation): Low –ve

iv) Area 7 is a large area of partly disturbed Swartland Shale Renosterveld within the military radio installation. The area has been disturbed by regular brushcutting, and relatively few indigenous species are present, compared to the undisturbed portions of the site immediately to the west (in quarry area). No rare or localised plant species are likely to occur in significant numbers within the proposed alignment, although a number of such species could occur as scattered individuals.

The Low route and its alternative are the two routes that impact on this area. The alternative along the eastern boundary is preferred, as the construction is less likely to interfere with sensitive areas nearby, as the entire eastern edge of the site has been disturbed.

Significance rating of Low route for Area 7 (before mitigation): Moderate -ve

Significance rating of Low route alternative for Area 7
(before mitigation): Low -ve

Mitigation

The Low route alternative should be used in this area. If this is not done very little mitigation is possible in this area.

Significance rating of Low route for Area 7 (after mitigation): Moderate -ve

Significance rating of Low route alternative for Area 7
(after mitigation): Low -ve

4. NO GO ALTERNATIVE

The maintainance of the status quo would be the preferred option in some cases, whilst in others it would have, or could have, a deleterious long term effect on the natural vegetation in the area, making it extremely difficult to give an overall assessment of the No Go alternative for the entire project. For example, in areas where the pipeline would impact on a strip of Renosterveld vegetation the No Go option would be preferred, but this is complicated by the fact that the landowner may allow dense alien vegetation to establish on the land in the future, in which case the conservation value of the site would gradually decline. Whether this would happen irrespective of whether the pipeline existed is impossible to predict. In some cases the mitigation proposed for the pipeline would have a low positive impact (eg. clearing of aliens in vicinity), where otherwise the likelihood is that aliens would have densified (a negative impact).

Overall however, the likely impacts of the No Go alternative are not significantly different from those of the development alternative after mitigation.

5. SUMMARY TABLE FOR BOTANICAL ISSUES

Location or Section	Significance before Mitigation	Mitigation	Significance after Mitigation
Dasbos pumpstation to Dasbos outlet	Moderate -ve	Clear aliens within 100m	Moderate -ve
Dasbos outlet to Klipmuts - High route + alternatives	Low to Mod -ve	Clear aliens within 100m	Low -ve
Dasbos outlet to Klipmuts - Low route + alternatives	Low -ve	Clear aliens within 100m	Low -ve
Dasbos outlet to Klipmuts - New Preferred route	Low -ve	Clear aliens within 100m	Low -ve
Site A pipeline alternatives - Muldersvlei area (no preferred route)	Moderate -ve	- Do not use alternative in Area A2 - Clear aliens within 100m - Search and Rescue of rare species in winter or spring	Moderate -ve
Site B pipeline alternatives - Muldersvlei area (no preferred route)	Moderate -ve	- B3 slightly preferable to B2 - Clear aliens within 100m - Search and Rescue of rare species in winter or spring	Moderate -ve
Site G pipeline alternatives - Muldersvlei area (no preferred route)	Low to Moderate -ve	- Do not use alternative in Area G1 - Clear aliens within 100m - Search and Rescue of rare species in winter or spring	Low -ve
Muldersvlei to Spes Bona - High route + alternatives	Moderate -ve	- Avoid Area 5 by using Alternative to south - Clear aliens within 100m - Search and Rescue of rare species in winter or spring	Moderate -ve
Muldersvlei to Spes Bona - Low route + alternatives	Low to Moderate -ve	- In Area 7 use alternative in east - Clear aliens within 100m - Search and Rescue of rare species in winter or spring	Low -ve
Muldersvlei to Spes Bona - Preferred route	Low -ve	Clear aliens within 100m	Low -ve
Site A – footprint	Low -ve	None required	Low -ve
Site B – footprint	None	None required	None
Site G - footprint	None	None required	None

6. REFERENCES

Cowling, R.M., Pressey, R.L., Heijnis, C.E., Richardson, D.M., Lombard, A.T. 1998. Systematic conservation planning for the CAPE project. Conceptual approach and protocol for the terrestrial biodiversity component. Institute for Plant Conservation Report 9803, University of Cape Town. Cape Town.

Cowling, R. and C. Heijnis. 2001. The identification of Broad Habitat Units as biodiversity entities for systematic conservation planning in the Cape Floristic Region. *SA J Bot.* 67: 15 – 38.

Helme, N. 2005. Specialist botanical scoping study for component 1 of upgrading of CCT bulk water supply infrastructure. Unpublished report for Orrie Welby-Solomon & Associates/BKS (Pty) Ltd. Nick Helme Botanical Surveys, Scarborough.

Jarman, M.L. 1986. Conservation priorities in the Cape lowland regions of the Fynbos biome. SA National Scientific Programmes report 87. CSIR, Pretoria.

Maze, K. and A.G. Rebelo. 1999. Core Flora Conservation Area on the Cape Flats. FCC report 99/1. Botanical Society of South Africa. Kirstenbosch, Cape Town.

McDowell, C. and A.B. Low. 1990. Conservation priority survey of the Cape Flats. Unpublished report. University of the Western Cape, Bellville.

Mucina, L. and M. Rutherford (eds.). 2006. Vegetation map of South Africa, Lesotho, and Swaziland. Strelitzia 19 South African National Biodiversity Institute, Pretoria.

Raimondo, D. et al. *In prep.* Updated Red Data Book of threatened plants of the Western Cape. To be published by the South African National Biodiversity Institute.

Rebelo, A., N. Helme, J. Victor, D. Euston-Brown, W. Foden, I. Ebrahim, B. Bomhard, E.G.H. Oliver, D. Raimondo, J. Van der Venter, R. van der Walt, C. Von Witt, C.N Forshaw, A.B. Low, C. Paterson Jones, D. Pillay, P.M. Holmes, S.H. Richardson, J.P. Rourke, and J. Vlok. *In Preparation.* Southern African Red Data list for Proteaceae.

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.

Von Hase, A., M. Rouget, K. Maze, and N. Helme. 2003. A fine-scale conservation plan for Cape Lowlands Renosterveld: Technical report. CCU Report # 2/03, Botanical Society of South Africa, Kirstenbosch.

Wood, J. and A.B. Low. 1993. Environmental survey and management guidelines for the Tygerberg and environs. Unpublished report. National Botanical Institute, Kirstenbosch.

Wood, J., Low, A.B., Donaldson, J, and A.G. Rebelo. 1994. Threats to plant species diversity through urbanization and habitat fragmentation in the Cape Metropolitan Area, South Africa. *Strelitzia* 1: 259-274.