CHAPTER NINE: SOIL SUITABILITY ASSESSMENT

9.1 INTRODUCTION

This chapter presents the findings of the specialist soil suitability assessment undertaken by SGS NVIROCROP and Mr F Botha of ECOsoil. SGS Nvirocrop did the soil classification field work and soil potential map. The study was commissioned as part of the EIA process in order to determine the suitability of the soils on the site proposed for agricultural expansion; and to refine the project layout by identifying areas most suitable for cultivation.

9.2 TERMS OF REFERENCE

The terms of reference for the study were informed by the technical requirements of the project proponent; specialist input and requirements of the soil specialists as provided by Dr Ellis; and the requirements in terms of the EIA process as defined by Public Process Consultants.

The soil suitability study includes the following:

- The classification and the determination of the agricultural potential of the soils of the designated area as part of the overall land use planning being undertaken by the client.
- Broad soil classification, chemical composition and agricultural potential to get baseline pertaining to the farm Riverbend in the district Kirkwood
- Compilation of a soils map on a suitable scale to describe the natural distribution of the soils.
- Description of the soils in the different soil types in terms of their physical and morphological properties.
- To identify the more important soil physical and/or morphological limitations of the soil types.
- Evaluation of the relative suitability of the different soil types in terms of irrigated citrus

9.2.1 Methodology and Approach

- In line with the scope of work it was agreed the site demarcated by the client for the proposed development would be assessed in terms of the soil types/forms using the Taxonomic Soil Classification System.
- The identification and classification of the soils was carried out using the South African Taxonomic Soil Classification System (Mac Vicar et al, 2nd edition 1991).
- A soil auger was used to sample in strategic places to identify any differences in soil types or depth, or any other soil physical properties that can have an influence on the soil forms and agricultural potential of the land.
- The investigation of the soils involved the traversing of the area on a grid base using a conventional 1.5m-bucket auger to investigate and log the soil profiles.
- Selected terrain information, topography and any other infield data of significance, and of relevance to the Pedological investigation, was also recorded and stored in an electronic format (data base), and the information mapped on a recognised GIS system
- Soil samples were also taken to determine the chemical composition of the different soil types.
- Soil quality assessment based on a soil classification done by SGS Nvirocrop
- Soil chemical analysis to assess general soil fertility and agricultural potential

- It has not yet been possible to gain access to the most northern portion of the area under assessment (Portion 1 and 3 of the Farm 77). Therefore the soil forms for this portion of the site have been extrapolated from those that have been classified on the northern portion of the RE/82 Wolvekop which have been surveyed and analyzed using the methodology described above.

9.3 SUITABILITY OF SOIL TYPES FOR CITRUS PRODUCTION

The regional geology of the area comprises predominantly Sedimentary material, Mudstones and Arenite material. The parent material and associated land types are presented in map 9.1 below.

Map 9.1 Parent material and associated land types.

The soils derived of these parent materials are predominantly heavy structured red and pedocutanic soils with come carbonate material in the subsoil with a generally high base status. This was confirmed through the soil chemical analyses report.

Map 9.2 Different land and associated soil types

The investigation of the soils involved the traversing of the area on a grid base using a conventional 1.5m-bucket auger to investigate and log the soil profiles. Selected terrain information, topography and any other infield data of significance, and of relevance to the Pedological investigation, was also recorded and stored in an electronic format (data base), and the information mapped on a recognised GIS system

The identification and classification of the soil profiles was carried out using the TAXONOMIC SOIL CLASSIFICATION SYSTEM (Mac Vicar et al, addition 1991).

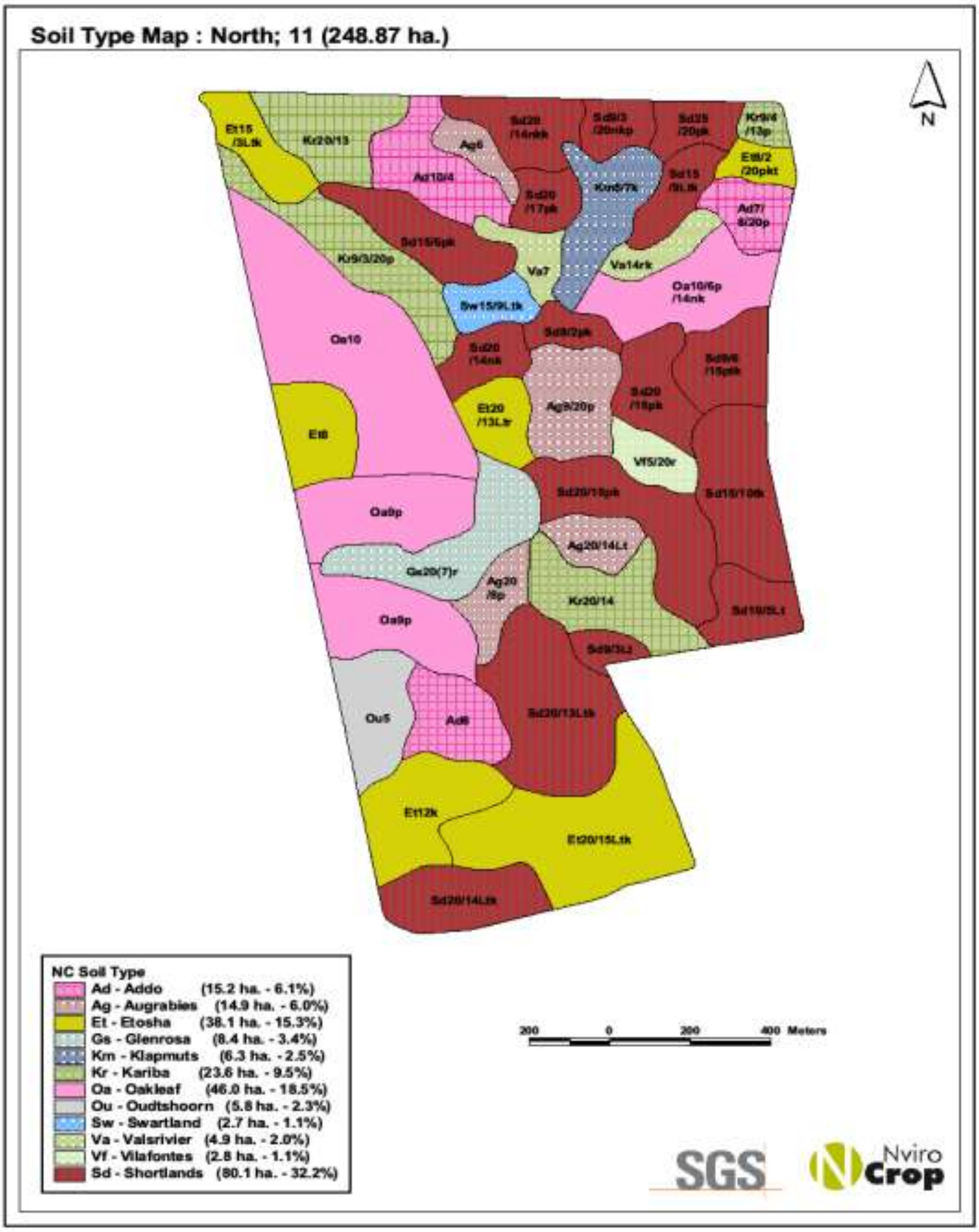
In this way, standardised soil identification and communication is allowed by use of the names and numbers given to the soils classified. The procedure adopted when classifying the soil profiles is as follows:

I. Demarcate master horizons
II. Identify applicable diagnostic horizons by visually noting the physical properties such as:
    - Depth
    - Texture
    - Structure
    - Mottling
    - Visible pores
    - Concretions
    - Compaction
III. Determine from i. and ii. the appropriate Soil Form
IV. Establishing provisionally the most likely Soil Family (pending the outcome of the laboratory tests)

9.3.1 Soil Analysis on the Northern Portion of the RE/82 Wolvekop

The detailed survey was carried out on a grid base, and the results were used to rank the potential of the soils for irrigation purposes. Samples were taken on every grid point in the dominant soil type and sent to Enviroteklab for analysis.

The soil forms and percentages that occur on the northern portion of the RE/82 Wolvekop are indicated in map 9.3 below.



Map 9.3 Soil types on the northern portion of the RE/82 Wolvekop

The table below indicates the following soil forms classified on the Northern portion of the RE/82 Wolvekop.

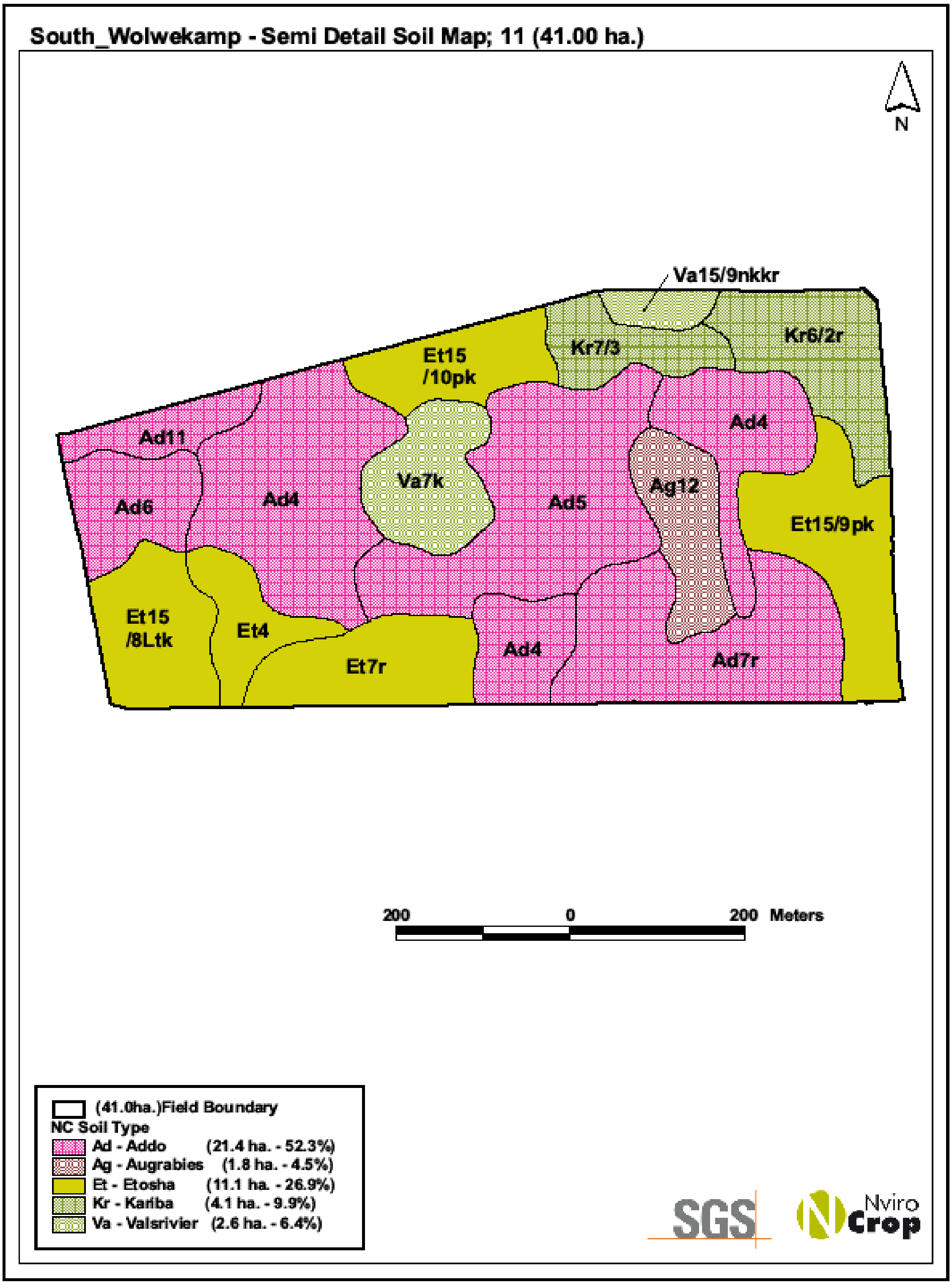
Soil Forms	Area (Ha)	Limitation
Shortlands, Oakleaf	190.9	Depth, structure
Augrabies, Addo, Etosha	63.3	Carbonate layer
Oudshoorn, Kariba	29.4	Depth, Carbonate layer
Glenrosa	8.4	Shallow depth, Rock and Gravel
Valsrivier, Swartland, Klapmuts, Vilafontes	16.7	Depth, Pedocutanic structure

Applying the criteria where possible to the soils that were mapped based on the limitations of the soils' chemical and physical characteristics and the site constraints. A combination of these variables was then used to obtain the agricultural potential of the soils. The Table below indicates the soil potential on the northern section of the RE/82 Wolvekop for citrus production.

Soil Potential of Management Units for Citrus production, Northern portion (248.9Ha)			
Potential	**Hectares**	**% of Area**	**Irrigation Classification**
High	190.9	76.6	2
Medium to High	19.8	7.9	2
Medium	17.8	7.1	2
Medium to Low	14.7	5.9	2-3
Low	5.8	2.6	3-4

9.3.2 Soil Analysis on the Southern Portion of the RE/82 Wolvekop

Map 9.4 shows the different soil forms and percentages of each on the Southern section of the RE/82 Wolvekop.



Map 9.4 Soil forms on the Southern Portion of the RE/82 Wolvekop

Using the classification methods outlined in this report, the following soil forms were classified on the Southern portion of the RE/82 Wolvekop.

Soil Forms	Area (Ha)	Limitation
Augrabies, Addo, Etosha	34.3	Carbonate layer
Kariba	4.1	Depth, Carbonate layer
Valsrivier	2.6	Depth, Pedocutanic structure

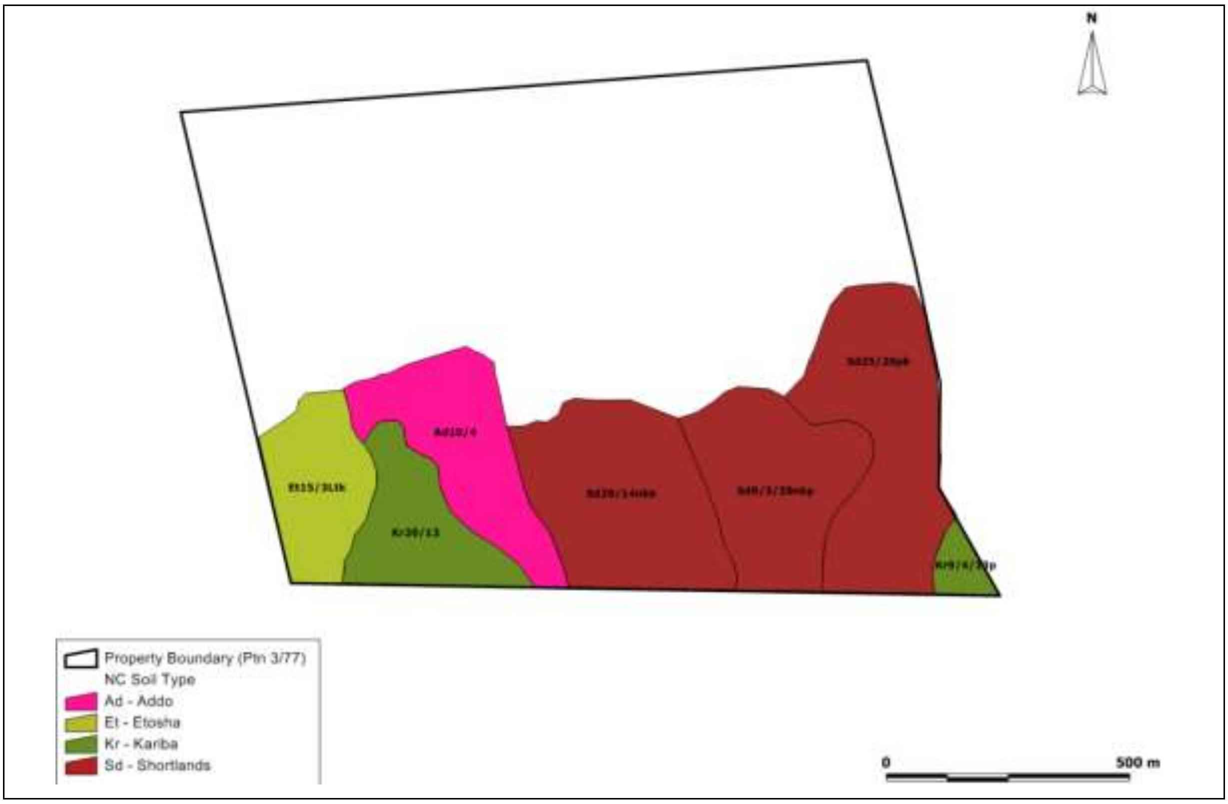
A combination of the variables was then used to obtain the agricultural potential of the soils. The Table below indicates the soil potential on the southern section of the RE/82 Wolvekopfor citrus production.

Soil Potential of Management Units for Citrus production, Wolwekamp, Southern portion (41Ha)			
Potential	**Hectares**	**% of Area**	**Irrigation Classification**
High	11.1	27.1	2
Medium to High	5.0	12.3	2
Medium	15	36.5	2
Medium to Low	0	0	0
Low	9.9	24.2	3-4

9.3.3 Soil Analysis on Portion 1 and 3 of Farm 77

The soil forms for this portion of the site have been extrapolated from those that have been classified on the northern portion of the RE/82 Wolvekop which have been surveyed and analyzed using the methodology described in section 9.2.1 above. These soils have either High or Medium to High Potential for irrigation, and are therefore suitable for citrus production.

In the opinion of the soil specialists, it is inferred by means of similar slope, geology, plant species, and other means, that the Portion 1 and 3 of Farm 77 would also have arable, high or medium to high potential soils for irrigation and would be suitable for citrus production. At the point of development, a detail assessment of Portion 1 and 3 of Farm 77 would be done, based on intensive site visits, surveys and soil analysis. The soil forms that occur on Portion 1 and 3 of Farm 77 are indicated in Map 9.5 below.



Map 9.5 Soil types on Portion 1 and 3 of Farm 77

9.4 SOIL TYPES AND CHEMICAL PROPERTIES

The following provides an overview of the soil types and the chemical properties on the property.

Shortlands (Sd)

The Shortlands and associated Oakleaf soil Form are generally located in the upper and middle-mid slope positions.

- It has a red structured B Horizon in the sub-soil.
- It has a generally fast to moderate infiltration rate.
- The effective rooting depth is influenced by the moderate swelling and shrinking of the stable structures. It has the potential to break hair roots.
- These soils are well drained and shows no signs of waterlogging

Augrabies soil form

The Augrabies and associated Addo and Etosha soil Forms are located in the middle, lower middle and foot slopes.

- These soils contain lime in the sub-soil and have an unstable sub-soil structure.
- It tends to disperse, and should therefore not be disturbed with land preparation
- It has a generally fast to moderate infiltration rate.
- The effective rooting depth is influenced by the unstable structure, high carbonate content and soil consistency.
- These soils are well to moderately drained and shows no signs of waterlogging
- Erosion is a potential hazard

Kariba (Ka)

The Kariba soil Forms are located in the middle, lower middle and foot slopes.

- These soils contain lime in the sub-soil and have an unstable sub-soil structure.
- It tends to disperse, and should therefore not be disturbed with land preparation
- It has a generally fast to moderate infiltration rate.
- The effective rooting depth is influenced by the unstable structure, high carbonate content and soil consistency.
- These soils are well to moderately drained and shows no signs of waterlogging
- Erosion is a potential hazard

Valsrivier

The Valsrivier and associated Swartland, Klapmuts and Vilafontes soils generally occur on the foot slopes and valley bottom in the landscape.

- It has strong pedocutanic structure in the sub-soil
- It tends to disperse when exposed to the atmosphere
- Has a slow infiltration rate and slow drainage potential
- With over irrigation it tends to waterlog.
- There is a potential of sodicity and salinity with poor water quality and irrigation practises.

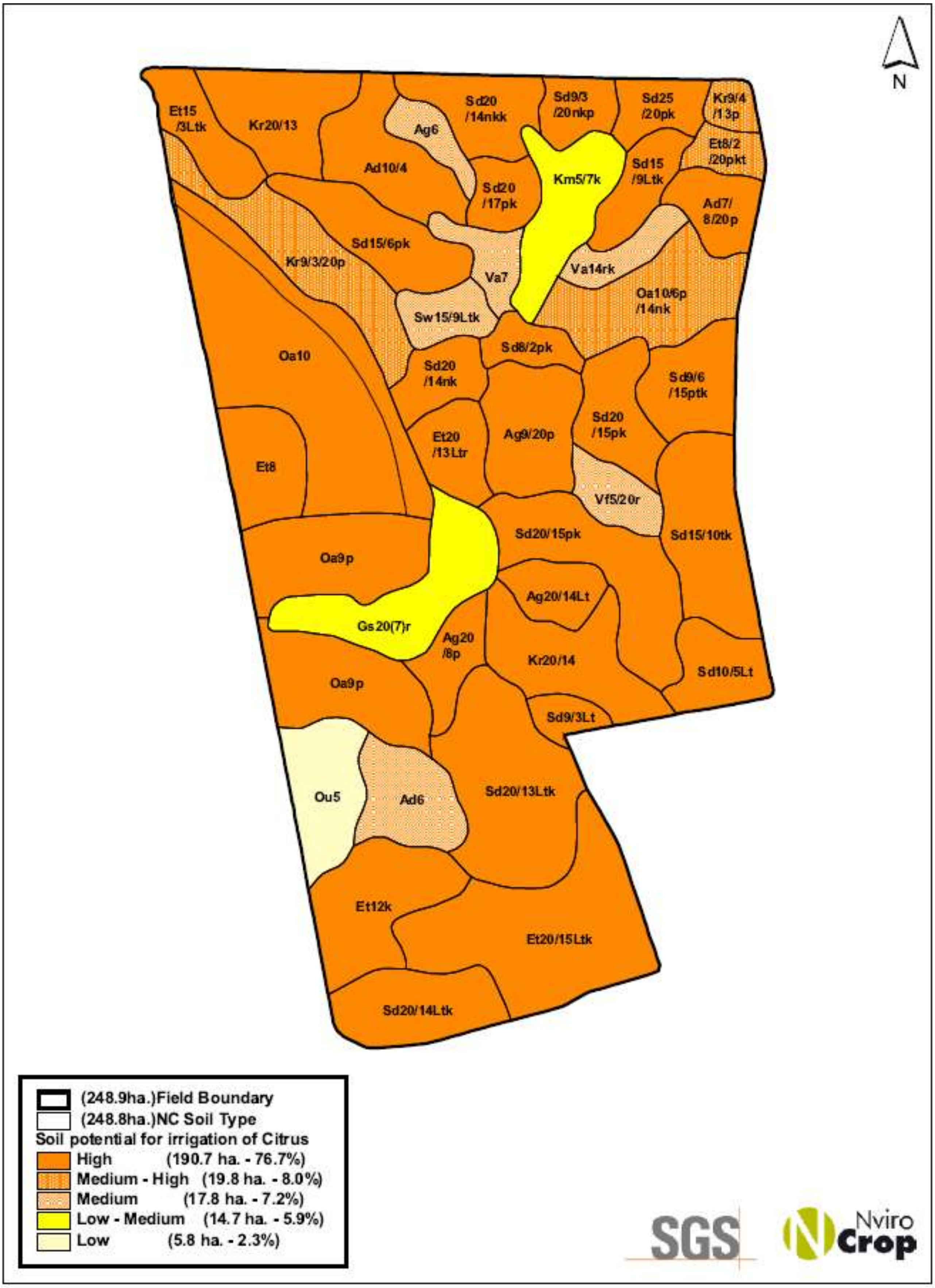
9.4.1 Soil Chemical Properties

Based on the soil chemical analysis the following is relevant to the soils analysed on the property.

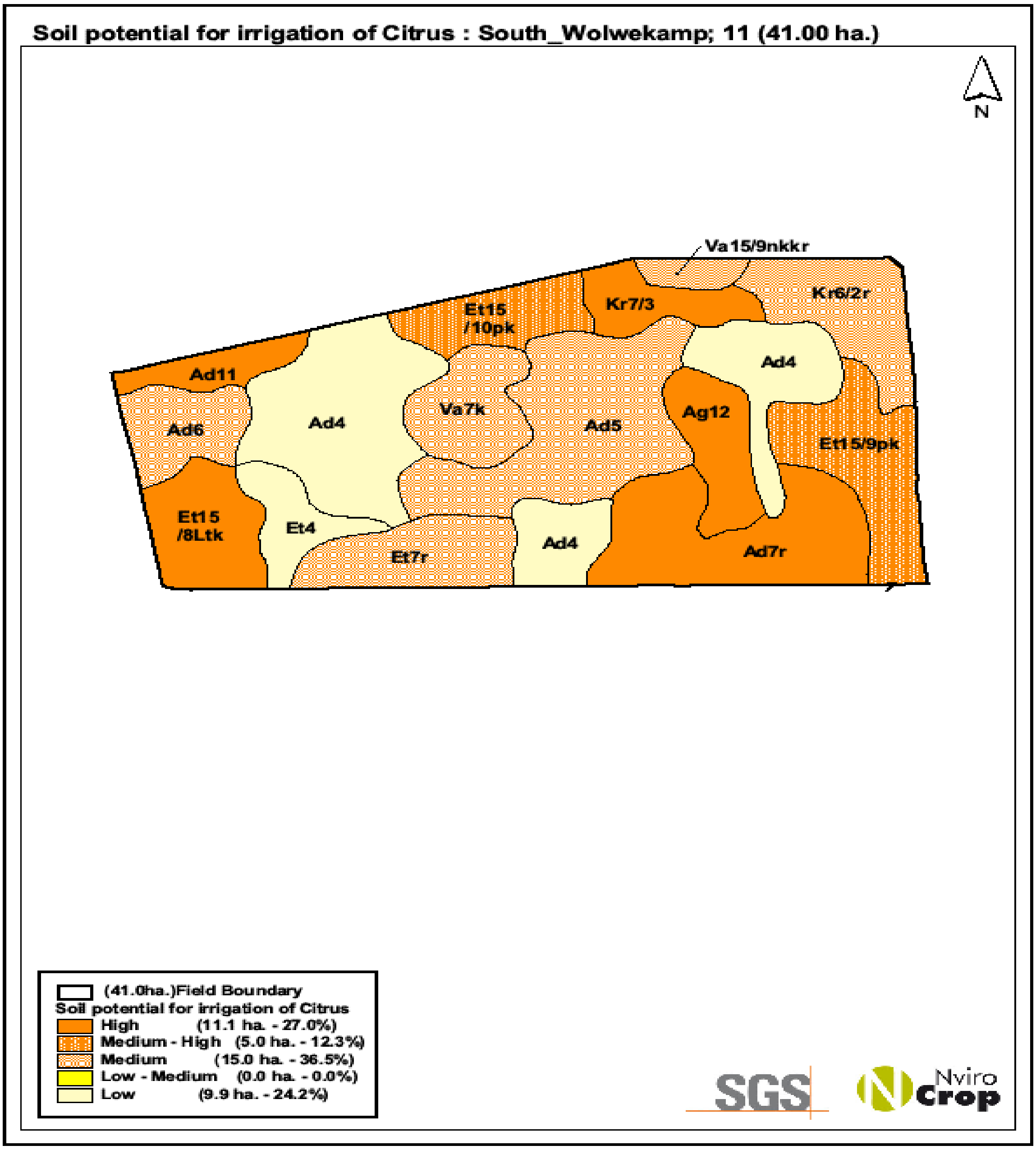
- The pH of most soil forms are high and the soils to be alkaline. This is an indication of the influence of the sedimentary rock and mudstones that has a high Calcium and Magnesium content.
- The phosphate (P) levels are low and should be built up according to citrus norms.
- The potassium (K) levels are normal to low in comparison to calcium (Ca), magnesium (Mg) and sodium (Na), which can induce a potassium deficiency in plants.
- The chemical imbalances that exists (high Mg and Na levels), will contribute to certain soil physical limitations like crust formation on the topsoil and the high erodibility creating gully and donga erosion.
- The clay% and action exchange capacity is high.

9.5 POTENTIAL OF THE DIFFERENT MANAGEMENT UNITS

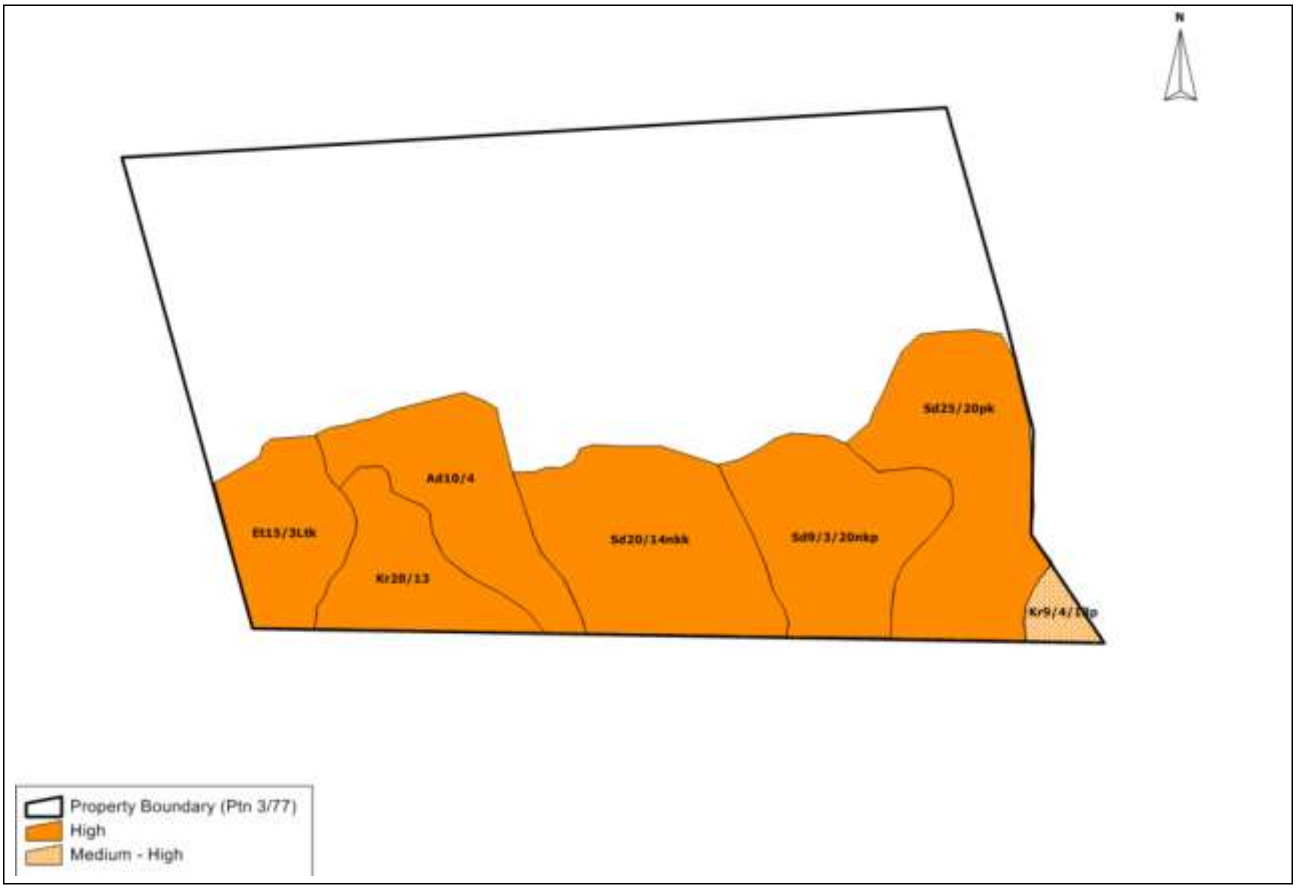
Based on the soil types and chemical analysis the soil potential of the different management units on the property was mapped for their suitability for citrus production. Map 9.6, 9.7 and 9.8 below provides an overview of the soil suitability on the properties.



Map 9.6: Soil suitability for irrigation of citrus on the northern portion of the RE/82 Wolvekop



Map 9.7: Soil suitability for irrigation of citrus on the southern portion of the RE/82 Wolvekop



Map 9.8: Soil suitability for irrigation of citrus on Portion 1 and 3 of Farm 77

9.6 CONCLUSIONS AND RECOMMENDATIONS

Northern Portion of the RE/82 Wolvekop

- All the soils are suitable for irrigation purposes, though some areas will need special management practises like ridging and/or drainage to leach the soils of excess water and alleviate the build-up of salinity.
- The shallow soils are low potential soils. Special management practises like ridging to improve effective rooting depth will have to be implemented.
- The pedocutanic soils are medium to low potential soils due to the hard consistency and blocky structure of the soils.

Southern Section of the RE/82 Wolvekop

- All the soils are suitable for irrigation purposes, though some areas will need special management practises like ridging and/or drainage to leach the soils of excess water and alleviate the build-up of salinity.
- The shallow soils are low potential soils. Special management practises like ridging to improve effective rooting depth will have to be implemented.
- The pedocutanic soils are medium to low potential soils due to the hard consistency and blocky structure of the soils.

Portion 1 and 3 of Farm 77

- All the soils are anticipated to be suitable for irrigation purposes, though some areas may need special management practices like ridging and/or drainage to leach the soils of excess water and alleviate the build-up of salinity.
- At the point of development, a detail assessment of Portion 1 and 3 of Farm 77 would need

to be done, based on intensive site visits, surveys and soil analysis.

9.6.1 General Summary and Concluding Remarks

- The areas surveyed are suitable for citrus production under irrigation
- The ph (KCl) values are normal to high. This is due to the high base saturation of the soils.
- There is no evidence of high exchangeable sodium (ESP) values in the soil analyses.
- Regular monitoring of water quality, sub-soil salinity and sodicity needs to be done to maintain soil fertility and sustainable citrus production.
- Proper irrigation design and Irrigation scheduling management will be necessary to alleviate over irrigation on the heavy structured soils and the resulting waterlogging and sodification.

9.7 REFERENCES

- The Dept of Agriculture’s website (Agis) was used to determine the land capability and land types.
- The SA Taxonomic system for soil classification was used to identify the soil forms on the proposed site.

9.8 GLOSSARY OF TERMINOLOGY

- **A-Horizon (30)**. The depth of the topsoil horizon.
- **B-Horizon (100)**. The bottom end of the sub-soil horizon.
- **Effective rooting depth (ERD)**. This is the average depth that roots will develop under irrigation or where they are limited by an impeding layer. The effective rooting depth is the most important from a management perspective, which includes irrigation design, water holding capacity, drainage and nutrition.
- **W** - Wetness in the soil. This is an indication of drainage problems.
- **W1 –** Temporary wetness in the sub-soil. Slight mottling occurs in the sub-soil.
- **W2 –** Soil has a bleached / greyish colour with stronger mottling. Indication of serious water logging for longer periods of the year.
- **W3 –** Permanent water logging for most parts of the year. Dark grey soil matrix with serious mottling. Free water visible in profile pit.
- **G –** The percentage (G3 = 30%) of gravel soil (>2mm) in the total soil profile. This portion has a huge influence on the water holding capacity and water movement (permeability) in the soil.
- **R** – The percentage of rocks in the profile. This has an influence on land preparation as well as the water holding capacity of the soil.
- **Available moisture or water content per meter soil (AWC mm/m)** - It is the amount of water available in a meter of soil.
- **Total available moisture (TAM)** – It is a calculation between the AWC multiplied with the effective rooting depth (ERD). TAM values are therefore the most important value to determine from an irrigation design and scheduling perspective.
- **Freely available moisture (FAM) –** It is 50% of the TAM value. This value will determine how short the irrigation cycles will be when taking the daily evaporation figures into consideration.
- **Consistency-** The soil property indicating the hardness of the soil or resistance to change due to mechanical pressure.
- **Soil Structure-** The aggregation of the soil in small units called peds.