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Shire of Rockingham - A Study of Land Resources and Planning Considerations

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Disclaimer

The contents of this report were based on the best available information at the time of publication. It is based in part on various assumptions and predictions. Conditions may change over time and conclusions should be interpreted in the light of the latest information available.

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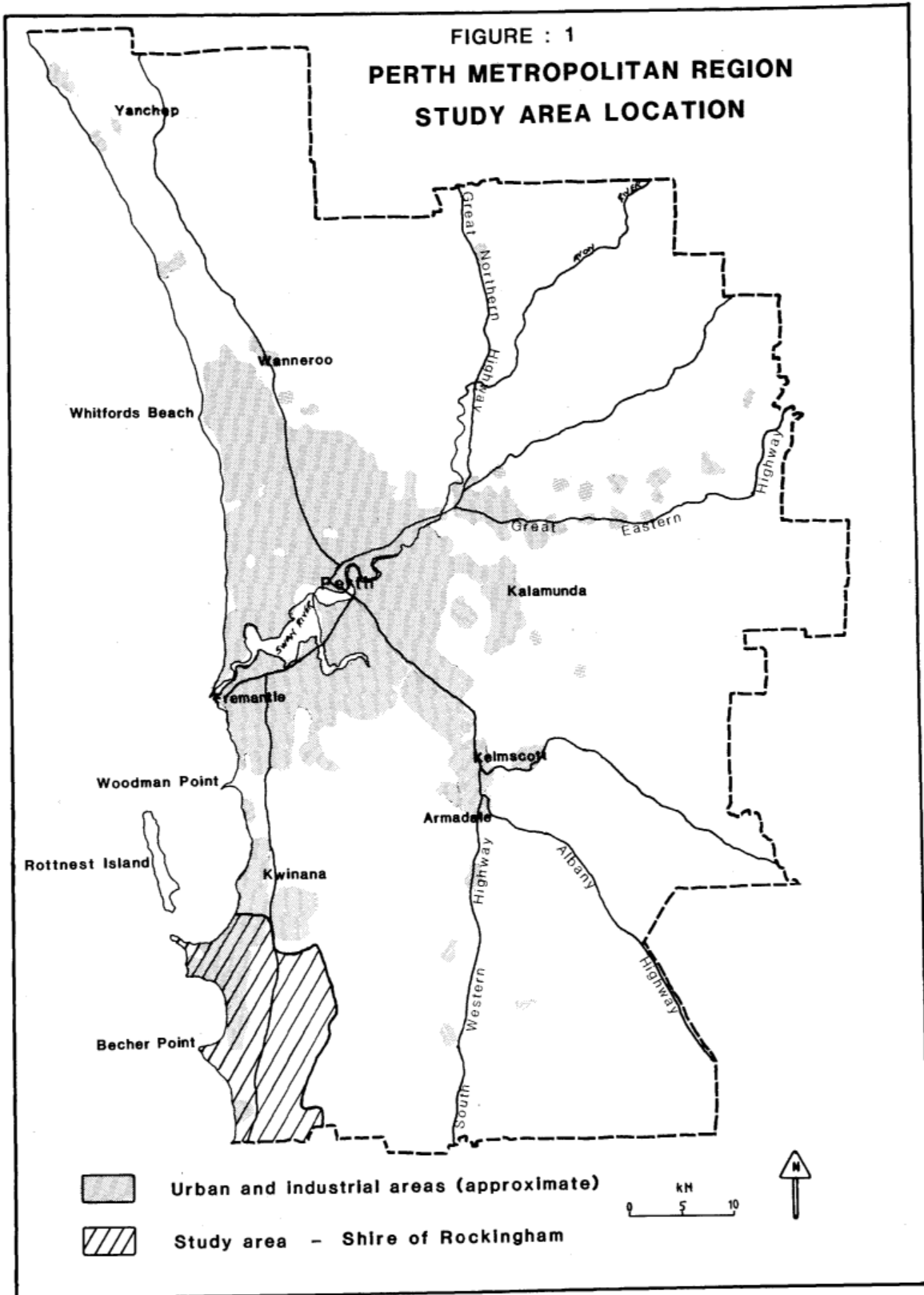
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1. Introduction

The Division of Resource Management is able to assist regional land use planning through the provision of mapped information on the nature and distribution of land resources. These maps deal principally with soils and land forms and their capability for various land uses. On the coastal plain of the Perth Metropolitan Region where pressures for land use changes are continual, the Division conducts resource mapping and interpretive work in relation to specific requests from local government authorities or State Government departments involved in planning.

This report is in response to requests received from both the Shire of Rockingham and the Main Roads Department. The Shire of Rockingham requested land resource information as a basis for reviewing its planning scheme. The Main Roads Department request was in relation to a study of land in the proposed corridor of alternative routes for the future southerly extension of the Kwinana Freeway. The location of the study area is shown in Figure 1.



2. Planning Scheme Review - General Considerations

2.1 Capability of Land and Land Degradation Hazards

To minimise the potential for land degradation all land developments within the planning scheme area should aim to

- (a) be sympathetic to the natural landform and soil conditions,
- (b) afford protection to sensitive wetland and coastal dune areas, and
- (c) retain as far as practical the natural vegetative cover.

To assist this objective, the accompanying land resource maps, (1,2,3) based upon information in section 3, have been prepared:

Map 1 provides a framework for the consideration of natural site constraints and opportunities for future land use.

Map 2 shows areas which have a high capability for market gardening or horticultural use. It is important to note that the assessment is based on landform and soil characteristics only and that water availability has been similarly mapped. Water availability must be determined on a site by site basis by consulting the Water Authority of Western Australia.

Map 3 shows areas which are considered highly sensitive to land degradation. The capability of these areas to sustain any form of residential development without incurring significant environmental damage is very low. It is recommended that the highest hazard areas be excluded from any future land developments.

The effects of, or potential for land degradation in all other areas can be minimized through the consideration of basic soil conservation principles and the nature of the land resource itself during any development. Council would be able to assist by the application of land use and management controls through zoning provisions for individual developments. Specific development guidelines for small rural lots are discussed in Appendix 1.

2.2 Protection of Good Quality Agricultural Land

2.2.1 Market Gardening

The market gardens within the Shire of Rockingham are of significance to the Perth Metropolitan Region due to a number of factors listed below:

1. Low transport costs and time (for perishable items) compared with other rural areas.
2. High availability of labour.
3. Aesthetic factors, to 'break up' urbanized stretches.
4. General availability of suitable groundwater (providing expansion is strictly monitored to avoid excessive localised water extraction).
5. Area is generally free from frost and extremes of summer heat.

Because of these factors the use of land for market gardening should be clearly identified, and encouraged within the Shire's rural planning strategy. In support of this recommendation 8.12 of the Rural Small—Holdings Policy Study (1977), commissioned by the Town Planning Department and the MRPA, stated that the market gardening areas of Rockingham should be preserved for that use.

The area identified by the Department of Agriculture in 1974 as being suitable for market gardening, within the South West Corridor Study Report corresponds to the entire Spearwood dune system. However the more intensive land resource mapping conducted for this study enables the areas of highest potential (map units S4a, and to a lesser extent S2a) to be delineated from within the Spearwood System (refer Map 2).

Despite recognition of areas with high potential for market gardening, it is not considered desirable to simply rezone large continuous stretches of land ahead of demand for 'intensive agricultural use only' as water availability cannot necessarily be guaranteed for each lot. The availability of water at any one location varies considerably and the quality and quantity available is influenced by the extraction occurring in nearby areas.

The preferred strategy is for these areas to have market gardens interspersed with other rural land uses which require less water. The demand on underground water should therefore not be excessive in any one area and the possibility of salinization of supply through an in drawing of the coastal salt/fresh water interface should be reduced.

It is possible that the relocation of the Perth Markets from the central city to Canning Vale may result in a boost for market gardeners in the Rockingham region due to easier market access for growers. However any further market gardening development requiring large amounts of water will have to be assessed on a case by case basis by the West Australian Water Authority.

2.2.2 Poultry

Although not as intimately tied to the nature of the land as market gardening, the poultry industry is also important to the Shire due to the following factors:

1. The area is generally frost free and cool in summer.
2. The sandy soils are ideal for drainage.
3. It is favourably located with respect to the Egg Marketing Board and poultry feed supplies.
4. Surrounding market gardens utilize the poultry manure which may be difficult to dispose of otherwise.
5. Suitable water is generally available.

These factors make fostering of the poultry industry a desirable feature within the Shire's rural planning strategy.

2.2.3 Maintenance of Water Quality

Due to the importance of groundwater resources for irrigation and possible domestic and industrial consumption, great care should be taken to avoid groundwater pollution. In addition, the maintenance of the coastal lakes and wetland areas as biological and recreational resources is dependent on water quality which relates to activities on adjacent land. Nutrients and pollutants from agricultural fertilizers or from industrial or residential wastes may be detrimental to these. Consideration needs to be given to the ability of soils to accept and purify liquid wastes and to creating buffer zones separating conflicting land uses from water bodies and their recharge areas.

2.2.4 Subdivisions and Special Rural Zone Development

To prevent speculative subdivision and alienation of rural land from potentially productive agricultural uses, a policy of staged development of subdivision for special rural zones should be required. Subdivision should be permitted only after a certain occupancy or development level is achieved within existing small rural lots.

Within the Shire of Rockingham, the ridges of the Spearwood system (Units Slb, S2b), areas of the Bassendean system (Units Bl, B2) and Quindalup System (Units Qf 2, Qf 3), (Map 1) are generally capable of supporting subdivision and small lot residential development (lots generally greater than 1.5ha) providing due consideration is given to buffer zones from adjacent waterbodies and to the specific development factors discussed in Appendix 1.

Although quite capable of subdivision, it is generally desirable to resist pressure for subdivision in these rural areas in order to ensure that the demand is not speculative and that bona fide rural land users are not adversely affected by increasing land values and rates. Maintenance of larger sizes also retains flexibility for future planning of rural areas.

2.2.5 Coastal Foreshores

In addition to the Town Planning Scheme, it is recommended that the Shire of Rockingham prepare a foreshore management plan in consultation with the Departments of Conservation and Environment, and Agriculture (Soil Conservation Service).

A coastal hazard line delimiting areas susceptible to wind and particularly to wave erosion has been placed on Map 3. It is recommended that no permanent structures should be built to the seaward side of this line. The most appropriate uses for these areas are reserves for low intensity recreation and conservation.

The hazard line does not include all units adjacent to the coast which are highly susceptible to land degradation. This is because several major development proposals have been approved within the Shire, which include large scale dune recontouring and stabilization programmes. In these cases, the existing unstable landforms will be stabilized and the foreshore reserve is based on minimum widths to cater for wave erosion and sand management.

The Coastal Development Committee of the Town Planning Department has adopted a 100 year planning horizon for the coast. Therefore where the coast is eroding, the minimum recession reserve is the annual rate x

100. The coast immediately south of Becher Point has eroded 370 m between 1924 and 1979, approximately 6.7 m/year. Therefore the reserve here should be 700 m. In other areas the hazard line includes the following units: Qf 1, actively accreting areas (Qf 4) and areas which comprise unstable dunes(Qs and Qb).

3. Description of Land Resources and Specific Planning Considerations

The study area forms part of the western fringe of the Swan Coastal Plain (Bettenay et al. 1960). The Coastal Plain comprises sedimentary materials deposited as a result of river, wind, or marine activity, and stretches from the foot of the Darling Scarp to the coast. Its eastern portion, known as the Pinjarra Plain, is relatively flat and has soils formed from alluvium of predominantly Pleistocene age. The western portion of the Pinjarra Plain is overlain by the oldest of a series of three coastal dune systems, the Bassendean System. The Spearwood System occurs to the west of the Bassendean System. The Youngest, Quindalup Dune System, generally forming the present coastline, abuts and partly overlies the Spearwood System.

The Serpentine River flows in a general westerly direction across the plain until it reaches the dune systems and is deflected southwards. The river forms part of the Shire of Rockingham's eastern boundary. Estuarine and lagoonal sediments which fringe the lower reaches of the river, as well as the margins of the coastal lakes (Walyungup and Coo loongup), are referred to here as the Vasse System.

Each of the geomorphic elements mentioned above has distinctive geology, topography, drainage status and soils. Thirty five discrete landform/soil mapping units, or components of these elements have been recognized and are shown on Map 1 at a scale of 1:25000.

3.1 *Pinjarra Plain*

This geomorphic element is a broad low relief plain formed on predominantly Pleistocene alluvial sediments. The major soils are generally poorly drained yellow duplex (sand over clay), or uniform black, grey or brown clays. The area is generally low lying and subject to seasonal waterlogging.

Eight mapping units have been identified as follows:

- P1 Flat to gently undulating plain with deep imperfectly drained, yellow duplex soils, with sandy loam topsoil over clay subsoil.
- P3 Flat to gently undulating plain with deep, imperfectly drained, gradational yellow or grey—brown earths and yellow duplex soils, with loam to clay loam topsoil over clay subsoil.
- P4 Poorly drained plain with deep, black and grey cracking clays, sometimes with gilgai microrelief.
- P4a Sandy margins of the plain with a shallow grey sand veneer over deep, black and grey cracking clays.
- P6c Flat to gently undulating alluvial terraces and fans at the same general level as the major part of the plain, but with better drained soils. The soils are moderately deep to deep, uniform friable brown barns, or well structured gradational brown earths.

- P7 Seasonally inundated swamps and depressions with poorly drained, variable yellow or gley duplex soils.
- P8 Broad drainage pathways with ill—defined stream channels and poorly drained, yellow or gley duplex soils.
- P9 Minor creeks within the plain, with generally shallow to moderately deep, incised stream channels and variable yellow or gley duplex soils.

Planning Considerations: —

1. Poor site drainage and very low subsoil permeabilities severely restrict the potential of these areas for any significant urban or rural residential development unless further drainage is undertaken. Subsoil clays, particularly in units P4, P4a and less commonly P3, may have significant seasonal shrink—swell properties affecting stability of building foundations. Many house sites would need to be located on sand pads to alleviate drainage problems and permit on—site effluent disposal.
2. The agricultural potential of the plain is largely limited to grazing due to waterlogging and possible salinity problems. Exceptions are areas of unit P6c which are somewhat better drained and could be used for more intensive forms of agriculture than grazing.
3. The SW Corridor Planning Strategy Report (MRPA 1980) identified the Pinjarra Plain as being significant in terms of water resource development because it acts as a recharge area for the shallow artesian aquifer. Rural land uses were suggested as being more appropriate than other forms of development, to maintain groundwater quality for this area.

3.2 Bassendean Dune/Plain System

This system consists of low to very low relief Pleistocene sand dunes, intervening sandy and clayey swamps and gently undulating sand plain. The Bassendean system occurs immediately west of, and partially overlies the Pinjarra Plain. The dominant soils are deep, grey siliceous sands and bleached sands with an underlying iron—organic hardpan. Site drainage is rather poor with scattered shallow lakes and swamps occupying former swales. The water within these is typically stained brown by organic material and is of low salinity and high acidity. In some areas man—made drains supplement natural drainage patterns.

Four mapping units have been identified as follows:

- B1 Low to very low relief dunes and areas of sand plain with deep, bleached grey sands with either a pale yellow sand subsoil, or an iron—organic hard pan, at depths generally greater than 2 m.
- B2 Sand plain with deep, well drained, bleached grey sand with an iron—organic hardpan, or less commonly a pale yellow sandy subsoil, generally at 1—2 m depth.

- B3 Depressions, seasonally inundated swamps and ill—defined stream channels with moderately deep, poorly drained, bleached sands with an iron organic pan at generally less than 1 m depth. Surface soil is dark grey sand or sandy loam.
- B4 Broad poorly drained plain with deep, grey siliceous sands and bleached sands with a pan, underlain at depths generally greater than 1.5 m, by a mottled grey clay layer supporting a perched water table.

Planning considerations:-

1. The Bassendean System soils have low inherent fertility and low water holding capacity. However given sufficient fertilizer and irrigation the better drained areas (Units B1,B2) can be used for market gardening.
2. Areas of Units B3 and B4 with shallow underlying watertables also have some potential for market gardening due to the low pumping costs for irrigation. However areas currently subject to seasonal inundation would require drainage. Areas too wet for market gardening are useful as summer pastures for grazing.
3. The acidity of groundwater within Bassendean System may be a limitation for irrigated agriculture. It is generally desirable that pH at the groundwater be close to neutral (6.0—7.5) however in many areas close to swamps in former swales the water is more acidic.
4. There is potential for wind erosion of the well drained sands, particularly within Unit B1 if areas are denuded of vegetative cover by overgrazing or clearing.
5. Given sufficient compaction, soils of units B1 and B2 provide a good housing foundation base and are usually sufficiently deep to permit on site effluent disposal. Seasonal watertable levels within units B3 and B4 are likely to require house construction on sand pads.

3.3 Spearwood Dune/Plain System

The Spearwood system comprises a core of sandy aeolianite with a capping of secondary limestone overlain by yellow brown siliceous sands with weak podzol development. The system has an undulating surface, with some higher ridges and hills, and hollows representing dune swales. Differential wind erosion has resulted in some areas being stripped of sand to expose the limestone capping or pinnacles. Flat to gently undulating areas within or fringing the Spearwood system represent hind dune flats, extensive swales, or former marine limestone surfaces. The sands may develop a leached, grey surface horizon of variable depth and can intergrade with soils of the Bassendean system to the east.

Nine mapping units have been identified as follows:

- S1 Dune ridges with;

- (a) shallow to moderately deep, siliceous yellow—brown sands, very common limestone outcrop and slopes of 5—15%.
- (b) deep, siliceous yellow—brown sands or pale sands with yellow—brown subsoil, and slopes of 5—15%.
- (c) deep, bleached grey sands with yellow brown subsoils, and slopes of 5—15%.
- (d) moderately deep to deep, siliceous yellow brown sands, rare limestone outcrop and slopes of 15—25%.

S2 Lower slopes (1—5%) of dune ridge with;

- (a) moderately deep to deep, siliceous yellow—brown sands or pale sand with yellow-brown subsoils, and minor limestone outcrop.
- (b) shallow to moderately deep, siliceous yellow—brown sands and common limestone outcrop.

S3 Interdunal swales and depressions with gently inclined sideslopes and deep, rapidly drained, siliceous yellow-brown sands.

S4 Flat to gently undulating sand plain with:

- (a) deep, well drained, pale and sometimes bleached sands with yellow—brown subsoils.
- (c) deep, yellow-brown or dark brown siliceous sands that are seasonally inundated.

Planning considerations: -

1. The Spearwood Dune System is in demand for rural residential and hobby farm uses as well as for dryland farming and irrigated market gardening.
2. The sand plain, unit S4a, and to a lesser extent the lower dune ridges slopes, unit S2a, are particularly suited for market gardening purposes due to favourable climatic, topographic, and soil drainage conditions. The area is free of climatic extremes and the sandy soils are generally free of limestone, are deep, easy to work, freely draining and have groundwater at reasonably shallow depth. Although the soils have a low inherent fertility and water holding capacity, their location is sufficiently close to metropolitan markets to make high fertilizer and groundwater usage an economical proposition. Such areas are also quite productive under dryland farming conditions, especially when the land includes some swampy elements where perennial pastures can be maintained.
3. Areas of units S4c and parts of S3 have limited potential for market gardening due to high seasonal watertable levels and for the same reason are not well suited to any form of residential development.

4. The higher, steeper portions of the dune system, Units S1 and S2b, constitute more marginal agricultural land which is most suited to grazing due to the low water holding capacity of soils, and the short growing season.
5. Most areas of the Spearwood dunes are capable of supporting either urban or rural-residential development. The limestone is an adequate foundation for most structures and, with compaction, the sands are also suitable. For rural—residential densities, no problems are envisaged for on—site effluent disposal with the exception of unit S4c and areas of the dune ridge (Units S1b, S2a) adjacent to the coastal lakes immediately east of Mandurah Road. The ridge plays an important role as a recharge area for Lakes Coo loongup and Walyungup. To ensure recharge is not inhibited or polluted it is desirable that any residential development be sewer ed in this locality.
6. Steeper areas of the dune ridges S1d, and limited areas of S1b, have a moderate risk of soil erosion by wind and water, unless sufficient vegetative cover is preserved during any development. In general however, the risk of erosion under most established rural residential, urban, or agricultural land uses within the Spearwood system is minor. A notable exception observed during the survey was an area subject to severe overgrazing as a result of intensive stocking for the live sheep export market out of Fremantle.
7. Limestone outcrop within dune ridge Units (S1 and S2) is generally minor to rare in extent and poses a limitation only for agricultural activities including cultivation. In most lower slopes or flats, rocks have been easily removed from cleared areas. Within unit S1a however, the extent of rock outcrop is far greater, severely restricting any potential for agriculture beyond rough grazing. The limestone poses a significant limitation to residential use due to difficulties for on—site effluent disposal and construction.

3.4 Vasse Estuarine/Lagoonal System

This system comprises the low lying, very poorly drained flats, terraces and beach ridges fringing coastal lakes and the lower reaches of the Serpentine River. Soils are extremely variable, being formed on unconsolidated Holocene estuarine alluvium and lagoonal deposits, and are often highly saline and subject to periodic inundation.

Four mapping units have been identified as follows:

- V1 Saline flats and immediate margins of coastal lakes or the lower reaches of the Serpentine River. These areas are frequently inundated or flooded and have variable soils. Soils along the river are black organic sands, peaty barns and grey, black or brown sandy clays. Calcareous and shelby mud flats occur fringing the coastal lakes.
- V2 Flats marginally higher than V1, but still frequently inundated. Soils are as for V1.
- V4a Intermediate level terrace fringing the lakes. The deep calcareous soils comprise black loams overlying brown to grey silty clay and muddy sands at depth.

V6 Upper level undulating beach ridges fringing the lakes with deep, moderately well-drained, grey to pale yellow-brown calcareous sands.

Planning considerations:-

1. Units V1 and V2 have a very low to prohibitive capability for agricultural, urban or rural residential development due to their susceptibility to flooding, seasonal inundation, unconsolidated nature of the sediments, their salinity, and the high risk of pollution of adjacent water bodies.
2. Areas of unit V4a, whilst not as susceptible to inundation as units V1 or V2 also have a relatively low capability for any residential development due to the risk of polluting adjacent water bodies, the high winter watertable and the low permeability of soils if used for effluent disposal. The calcareous, saline nature of these soils makes them generally unsuitable for agricultural uses.
3. The upper level, undulating beach ridges are generally capable of supporting rural residential development, although some fill may be necessary to ensure efficient on-site effluent disposal.

3.5 Quindalup Dune/Plain System

This is a coastal dune formation of unconsolidated Hobocene aeolian deposits (Safety Bay Sand), occurring to the west of the Spearwood Dunes. The major formations are low, undulating beach ridge (relict foredune) plains. Moderately inclined to steep-sided, low relief, complex parabolic dunes and active foredune ridges also occur adjacent to the coast. The dominant soils are rapidly drained, uniform pale calcareous sands.

Ten mapping units have been identified as follows:

Active and Relict Foredunes

- Qf1 Active foredunes with ridge and swale topography and deep calcareous sands. The unit may consist of a single active foredune backing the beach or occur as a series of active and recently active, foredune ridges.
- Qf 2 Relict foredunes forming a plain which is topographically higher than the plain formed of unit Qf 3. The ridges are generally narrow and subdued compared to Qf3 ridges, and swales are not well developed.
- Qf2a More prominent relict foredune ridges which occur within unit Qf2. These occur either as single ridges or as a linear ridge complex. The ridges have previously been subjected to wind erosion forming small blowouts and parabolic dunes with swamps occupying small deflation basins in some areas. Linear swamps occupying well developed swales are often associated with this unit.
- Qf3 Relict foredunes forming a plain which is topographically lower than unit Qf 2. Ridge and swale topography is strongly developed and swamps frequently occupy the swales.

Qf 4 Contemporary relict foredune plain. An actively accreting system of very low, undulating relict foredunes backing the beach. These are generally poorly to moderately well vegetated with pioneer species.

Parabolic Dunes

Qp1 Nested parabolic dune complex. Deep calcareous sands with variable penetration of organic matter.

Qp2 Long walled, discrete parabolic dunes with deep calcareous sands.

Qd Deflation basin within parabolics.

Active erosional areas

Qs Active sand sheet.

Qb Active blowout.

Planning considerations:-

1. Soils of the Quindalup System owe their stability to their vegetative cover, which is highly susceptible to damage from people pressure (vehicular and pedestrian traffic).
2. Parabolic dunes (units Qp1 and Qp2) are topographically high and steep and are susceptible to wind erosion. These units should not be developed for residential use.
3. These areas are in demand mainly for beachside urban developments, rather than for any hobby farming or agricultural uses. Any agricultural use is severely restricted by the low water holding capacity of soils, groundwater salinity, unfavourable microclimatic conditions and generally high susceptibility of vegetation and soils to degradation.
4. Unit Qf2 is generally suitable for residential use as it is a low, gently undulating landform and is not generally exposed to onshore winds and wave action. The low ridges are easily levelled and compacted to provide a suitable surface for residential purposes. Larger steeper Qf2a ridges, may present problems of slope instability and difficulty in maintenance of vegetative cover unless recontoured and stabilized. Areas of linear swamps and seasonally waterlogged swales within Qf 2 are less suitable for residential development, unless filled.

4. References

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Appendix 1: Development Guidelines for Small Rural Lots

The following aspects of conservation land use should be considered for small lot developments or 'special rural' zones.

- provision of adequate water supply subdivision design lot sizes
 - access
 - development envelopes and set back distances
 - fire management
 - stocking limitations
 - vegetation protection
 - effluent disposal ability
- (i) Water Supply: Where a reticulated water scheme is not available, it is recommended that the provision of a reliable and adequate water supply for each lot be the responsibility of the developer. The subsequent costs of bore sinking or dam construction could be apportioned amongst all lots within a special rural zone development prior to sale.

Where bore water is to be used, the Western Australian Water Authority should be contacted to ascertain any permit requirements and water extraction restrictions.

- (ii) Subdivision design: Subdivision should be planned in a manner that will enable each block to be developed and managed in a practical and feasible way e.g. the location of boundaries on natural features such as drainage lines, ridges or contours ensuring practical access both to and within the lot to building sites and water supply points as well as for fire management. Boundaries diagonal to slopes or along intermittent flow lines are not recommended.
- (iii) Lot sizes: These should be related to the practical needs of the land use and to the natural attributes of the land in each case. Small lot sizes and closely spaced property boundaries may create difficulties for design and maintenance of soil conservation measures. They may also limit options for effluent disposal.

As a general consideration for hobby farm situations, large lot sizes will be required for steeper landforms for the following purposes:

- (a) Provision of stock feed requirements, due to the lower carrying capacity of steep slopes and the limited potential for fodder cropping;
- (b) preventing erosion of stock—tracks and firebreaks;
- (c) increase the number of sites suitable for provision of storage water (dams);
- (d) to provide adequate scope for safe access to building and yard sites;

(e) lower capacity of the soil to handle effluent wastes.

For commercial market gardening situations, lot sizes will be determined by water availability and the need to rotate land for disease control purposes. As a general recommendation the Department of Agriculture maintains that for newly establishing commercially viable market gardens a minimum of 20 ha is desirable. This figure relates to a perceived trend towards large gardens which are more suitable for mechanized operations.

(iv) Access: The planned alignment, construction and maintenance of subdivisinal roads and internal tracks should be considered in relation to existing landforms, water supply points, fire management needs and the proposed land uses. Specific areas which may require attention are:

- location
- road grade
- surface material
- surface drainage
- table—drains
- relief culverts
- drainage line crossings
- road batters
- topsoil management
- revegetation
- maintenance

(v) Development envelopes and setback distances: In order to limit site disturbance to the most capable areas within a rural—residential lot, all buildings and vehicular traffic circulation areas may need to be contained within an envelope defined by measurement to the lot boundaries. All lots should therefore be designed around adequate building envelopes. Clearing outside that envelope should be restricted to that required only for access and fire control. A general recommended set back distance from boundaries and streams is 20m. Boundary set backs may however need to be varied where topography and block shapes dictate.

(vi) Fire management: Fuel reductions, firebreaks and fire trails may be required as part of a fire management strategy. These may pose erosion hazards requiring the implementation of appropriate erosion control measures. See comments on access for specific areas of attention.

(vii) Stocking limitations: In many small hobby farm situations land holders are prepared to hand feed animals to a greater level than would be practical under general farming situations and hence high stocking levels are common. To prevent overgrazing and subsequent erosional topsoil loss it may be necessary to ensure that suitable summer grazing or housing facilities for stock are available to reduce stock impact on well grazed paddocks.

In larger farming situations however where hand feeding is minimal, the number of stock should be limited in accordance with the land's carrying capacity. The carrying capacity is the ability of pastures to carry grazing animals, and is usually expressed as the number of dry sheep that can be run on a year—round basis with minimal hand feeding.

Stocked at its carrying capacity, a pasture sustains grazing animals in a healthy condition, without the land being denuded of ground cover, particularly towards the end of summer. Sustained carrying capacity of pastures is however usually only possible by regular fertiliser applications

Advice on carrying capacities and fertiliser requirements for specific soil/land types in the Shire is readily available free of charge from the Metropolitan District Office, Department of Agriculture.

- (viii) Retention and protection of natural vegetation: In general, subdivision design should be such that minimal disturbance is afforded to existing natural vegetation. It may be desirable for Council to incorporate specific vegetation protection measures within special rural zones.
- (ix) Effluent disposal ability: In the majority of special rural areas disposal of septic effluent will be provided through on—site septic tanks and soil absorption fields. Special design considerations will be required to ensure efficient septic effluent disposal in seasonally waterlogged areas, or those with either shallow soils or very slow subsoil permeabilities. Effluent absorption fields should also be kept well back from drainage lines to minimise risk of pollution. For specific set back distances from drainage lines, desirable heights above the watertable, and suitable soil permabilities, the Department of Health should be consulted.