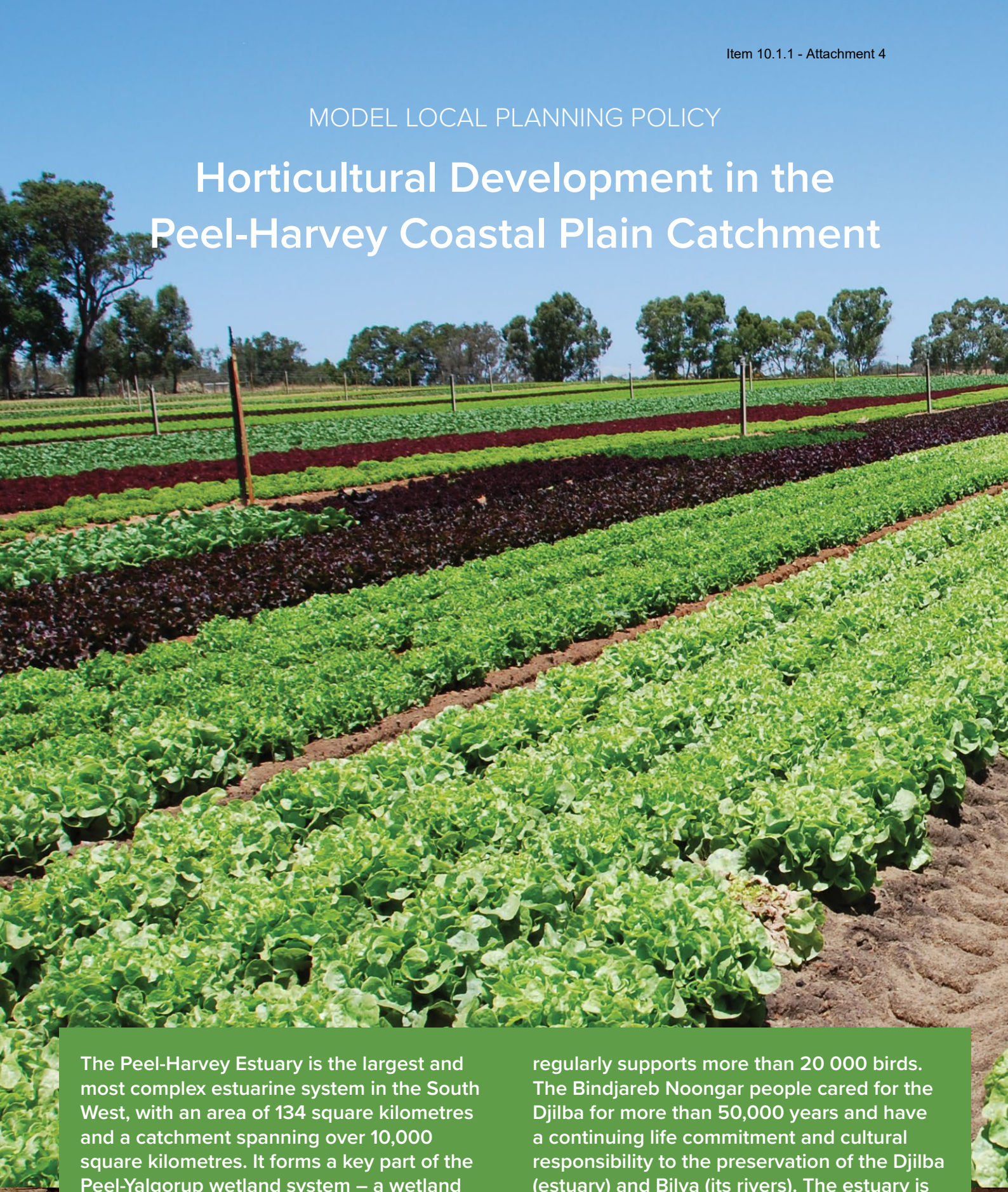
MODEL LOCAL PLANNING POLICY

Horticultural Development in the Peel-Harvey Coastal Plain Catchment



The Peel-Harvey Estuary is the largest and most complex estuarine system in the South West, with an area of 134 square kilometres and a catchment spanning over 10,000 square kilometres. It forms a key part of the Peel-Yalgorup wetland system – a wetland of international importance under the Ramsar Convention. The wetland system is important for waterbirds and waders, and regularly supports more than 20 000 birds. The Bindjareb Noongar people cared for the Djilba for more than 50,000 years and have a continuing life commitment and cultural responsibility to the preservation of the Djilba (estuary) and Bilya (its rivers). The estuary is also an economic and social asset of significant value, supporting a fishery, recreation and thriving tourism industry.

The Peel-Harvey Estuary has had a long history of degradation since European settlement primarily due to land clearing and drainage for the purpose of agriculture within its catchment. Soils types within this area are predominately of a poor quality poor for the retention of nutrients from fertiliser. As a result, phosphorus and nitrogen enter groundwater, watercourses, wetlands and reduce water quality in the receiving estuary, causing algal blooms, changing conditions for aquatic fauna and can lead to fish kills.

Agriculture remains an important industry in the Peel Region, and the area is well positioned to contribute to the food and nutrition security of the Perth Metropolitan area, and Western Australia. To realise this opportunity whist navigating the challenges of environmental impacts more intensive production such as horticulture and irrigated agriculture will require changes to established farming practices, alternative ways of managing soil and water and new or different types of farms and production systems.

Recognising the need for a robust and diverse industry, traditional intensive agricultural development should be sited in suitable soils within the catchment, as well as opportunities sought to increase productivity of existing farms through alternate cropping methods and innovation.

In 2015 the Sustainable Agriculture Futures working group, a consortium of local and state government and the Peel Harvey Catchment Council, prepared the Model Local Planning Policy Horticultural development in Local Governments of the Peel-Harvey Coastal Plain Catchment (2016). This instrument was designed for local government to adopt into their respective policy frameworks to inform planning decisions for horticultural development catchment of the Peel-Harvey Estuary.

Since this time, the Peel-Harvey Estuary Protection Plan (Bindjareb Djilba) has been released as a whole-of-government approach to protecting the Peel-Harvey estuary and its internationally recognised values. Additionally, strategic planning for the growing Perth-Peel Region, regional development initiatives into sustainable agriculture and new state policy for the consideration of water resources have also been undertaken by government.

The Model Local Planning Policy - Horticultural development in the Peel-Harvey Coastal Plain Catchment (2023) has been prepared in collaboration with Peel Harvey Catchment Council, Department of Primary Industries and Regional Development, Department of Planning, Lands and Heritage, Department of Water and Environmental Regulation and the Shires of Serpentine-Jarrahdale, Murray, Waroona and Harvey. The model policy is an update to its predecessor, and aligns with the objectives of existing state planning and environmental policies and the intent of the Bindjareb Djilba Protection Plan by providing proponents and decision-makers with an instrument to guide horticultural development for sustainable environmental and industry outcomes.

The Model Local Planning Policy - Horticultural development in the Peel-Harvey Coastal Plain Catchment has been prepared for local governments to suitably modify as considered necessary and adopt within their local policy framework.

Model Local Planning Policy

Horticultural development in the Peel-Harvey Coastal Plain Catchment

1.0 Citation

This is a Local Planning Policy prepared under Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015*. This Policy may be cited as ***Insert Policy Name*** Local Planning Policy.

2.0 Purpose

The Peel-Harvey Estuary system, and its waterways, is a vital natural and cultural asset of significant importance. The Bindjareb Noongar people have looked after the Djilba for more than 50,000 years and have a continuing life commitment and cultural responsibility to the preservation of the Djilba (estuary) and Bilya (its rivers). The estuary is also a Ramsar listed wetland of international importance[1] for migratory birds as well as a fishery, recreation and tourism asset of considerable value.

The Peel-Harvey Estuary has a long history of degradation since European settlement primarily due to clearing and then draining the land to establish farms within its catchments, which mainly consist of poor sandy soils which do not retain nutrients applied in fertilisers. Excess nutrients, mainly phosphorus and nitrogen, enter groundwater, watercourses, wetlands and reduce water quality in the receiving estuary, causing algal blooms, changing conditions for aquatic fauna and can lead to fish kills.

Horticultural production systems such as market gardens, turf farms and irrigated pasture, pose a significant risk to catchment water quality as they require high amounts of fertilisers to grow on the sandy soils of the coastal plain.

Given the sensitivity of the catchment to cumulative impacts of intensive agricultural land uses, planning decisions for horticultural development need to closely align with the capability of the land soils and landforms. Siting horticultural farms in suitable locations enables long term economic viability for proponents, encourages innovation and diversification of production operations, whilst ensuring the appropriate management of impacts to the Peel-Harvey Estuary.

This policy aims to encourage innovative and sustainable horticultural production in the ***insert local government name*** and prevent development in inappropriate locations so as to protect the water quality of the Peel-Harvey Estuary and its tributaries. It fulfils this purpose by providing:

- Information on the suitability of land for methods of horticulture and irrigated agriculture, with consideration to nutrient export risk and land capability, to meet catchment water quality improvement standards and inform decision-making; and
- Guidance on the investigations and information required to support planning proposals.

1. Fisher, S (2022). *Ramsar 482 – our community protecting a Threatened Ecological Community*, Wetlands Australia Issue No. 35.

3.0 Objectives

The objectives of this policy are:

3.1 To ensure new horticultural and irrigated agriculture enterprises pose a low risk to catchment water quality by locating such development on suitable land in the Peel-Harvey coastal plain catchment; and

3.2 To encourage innovative and diverse horticultural and irrigated agriculture enterprises within the Policy Area which are compatible with Catchment Water Quality Improvement Standards.

This policy is consistent with the objectives of the following environmental and planning instruments:

- *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992*
- *State Planning Policy 2 - Environment and Natural Resources*
- *State Planning Policy 2.1 - Peel-Harvey Coastal Plain Catchment (under review)*
- *State Planning Policy 2.5 - Rural Planning (2016) and the Rural planning guidelines*
- *State Planning Policy 2.9 - Water for Planning (draft)*
- *Peel Region Scheme Priority Agricultural and Rural Land Use Policy (2017)*
- *Greater Bunbury Region Scheme Agricultural and Rural Land Use Policy (2017)*

4.0 Applications subject of this Policy

The policy applies to proposals for new, or expansion of existing, horticulture and irrigated agriculture within the ***insert local government name*** which are located within the Peel-Harvey Coastal Plain Catchment as outlined in *State Planning Policy 2.1 - Peel-Harvey Coastal Plain Catchment* and draft *State Planning Policy 2.9 Water for Planning* and as shown in Figure 1.

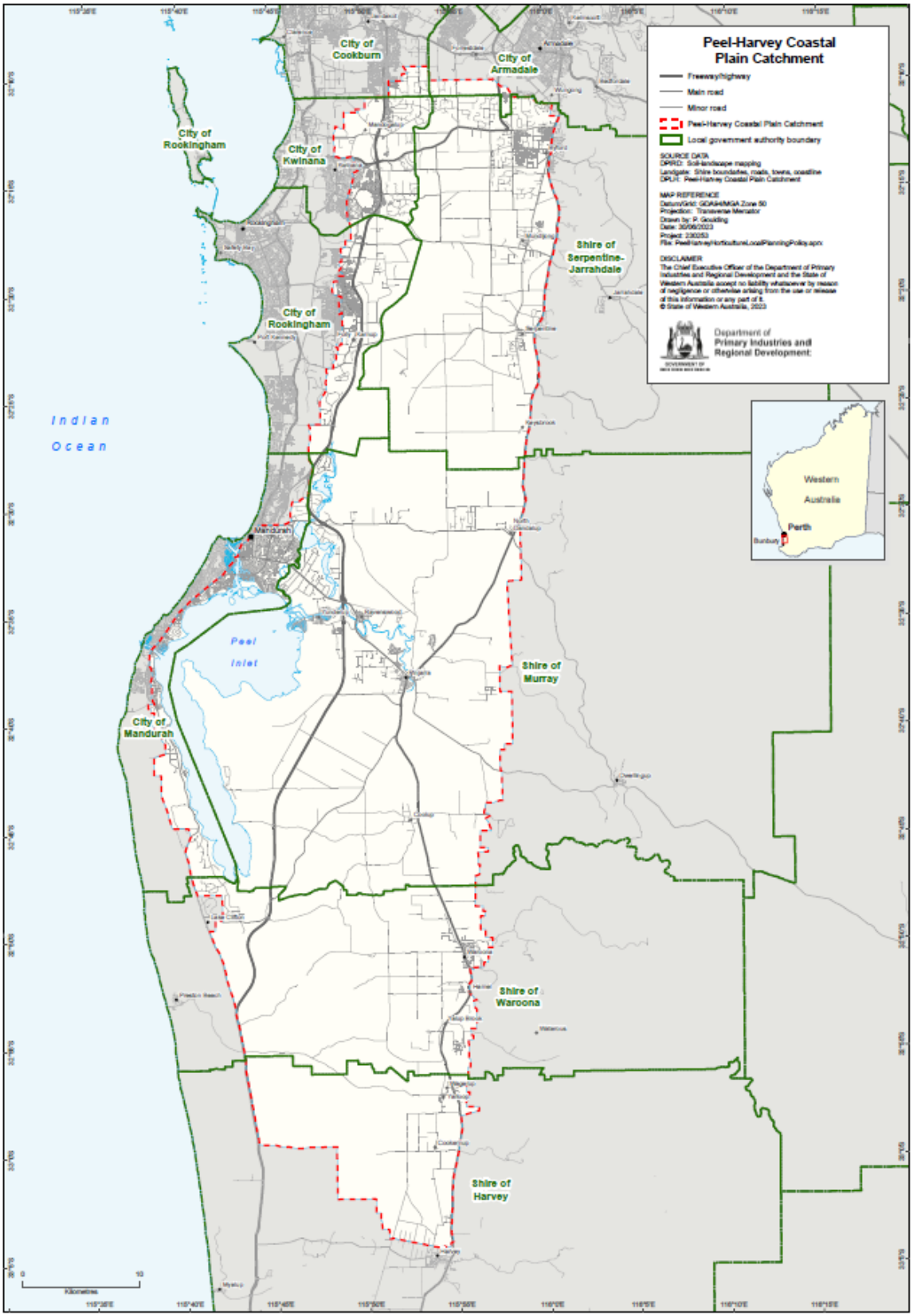


Figure 1: Peel-Harvey Coastal Plain Catchment

5.0 Policy Statement

In determining or providing advice on horticultural and irrigated agriculture proposals, the following provisions shall apply:

5.1 Proposals for horticulture and irrigated agriculture should pose a low risk to catchment water quality, the environment and land resources.

5.2 Proposals for horticulture and irrigated agriculture should be located within areas of appropriate land suitability2 to manage the specific type of operation proposed, without detrimental impact to water resources. Land suitability for the different soil-landscape mapping units of the Peel-Harvey Catchment is provided in Appendix A.

5.3 There is a general presumption against proposals for in-ground horticulture and irrigated agriculture in the Peel-Harvey Coastal Plain Catchment located on soil-landscape mapping units which are not suitable for the proposed operation due to their high nutrient export risk.

5.4 Proposals for closed production systems such as hydroponics and nurseries, or other innovative methods, may be considered on low suitability land however need to demonstrate any discharges can be managed within catchment water quality targets for nutrients (Section 6.0).

5.5 Proposals to diversify crops or change irrigation and agronomic practices so that water and nutrients are used more efficiently, that is for higher production and reduced water quality impacts, should be encouraged.

5.6 Proposals should avoid impacts to areas of remnant vegetation and wetlands.

5.7 Consideration shall be given to the advice of the relevant government departments, including the Department of Primary Industries and Regional Development and Department of Water and Environmental Regulation, when making determinations on horticultural proposals. For example, such advice may include the:

a) Adequacy of soil testing regimes;
b) Review of results and analysis of soil testing and other site testing;
c) Likely implications of the proposal on catchment water quality;
d) The level of risk posed by the proposal to catchment water quality; and
e) Assessment of groundwater availability to the site.

5.8 When determining proposals, the local government may give consideration to imposing conditions, among others, so as to minimise the ongoing risk that the development may pose to catchment water quality, such as:

a) Conditioning the ongoing operation of the development on the results of surface and groundwater monitoring.
b) Conditioning the ongoing operation of the development on the implementation of contingency measures, as triggered by the results of surface and groundwater monitoring.

5.9 The local government shall consider any other relevant matters, when assessing all proposals for horticulture or irrigated agriculture.

2. Land suitability for soil-landscape units of the Peel-Harvey Catchment is provided in Appendix A. Interactive mapping can be found at https://dpird.maps.arcgis.com/apps/webappviewer/index.html?id=244a530e57d94b5b8569d8e8ee4f2111

6.0 Application requirements

Development applications for horticulture and irrigated agriculture proposals should be supported by a Nutrient and Irrigation Management Plan[3]. Information within the plan may include, but not be limited, to:

- Site conditions:
  - Mapping of soil type(s)
  - Location of vegetation, watercourses and wetlands.
  - Depth to groundwater in winter.
- Site plan of cropping area and infrastructure.
- Confirmation of, or substantial progression towards, access to necessary irrigation supply.
- Evidence of due regard to any relevant state or local planning policy requirements.
- Site-specific soil survey and land capability assessment for the proposed land use.
- Crop, cultivation and irrigation information.
- Fertiliser regimes, nutrient content and distribution methods.
- Analysis of nutrient pathways on the site and areas of greatest risk.
- Soil and water nutrient monitoring regimes.
- Contingency actions to be undertaken by proponent if monitoring reveals site is exporting unacceptable nutrient loads.

Additional to the above, proposals for horticulture or irrigated agriculture in the Peel-Harvey Coastal Plain Catchment located on soil-landscape mapping units of high nutrient export risk, will be required to demonstrate the management of nutrients within Peel-Harvey catchment water quality targets through either:

- A nutrient application rate of 45 kg/ha/year total nitrogen of 6.5 kg/ha/year total phosphorous; or
- A nutrient export rate of 2.4 kg/ha/year total nitrogen and
  - 0.29 kg/ha/year for sites in the Serpentine River sub-catchment;
  - 0.28 kg/ha/year for sites in the Murray River sub-catchment;
  - 0.47 kg/ha/year for sites in the Harvey subcatchment[4].

Proposals in soil-landscape mapping units with low and very low capability for the proposed use, and a lower nutrient export risk, will need to demonstrate that the site limitations can be managed through crop selection, design and operation. A common example is growing summer vegetables to avoid waterlogging during winter.

7.0 Consultation

Advertising of applications for horticulture and irrigated agriculture will be undertaken in line with Councils ***insert name of advertising LPP*** or procedure.

3. *Water Quality Protection Note 33 – Nutrient and Irrigation Management Plans* - https://www.wa.gov.au/government/publications/wqpn-33-nutrient-and-irrigation-management-plans
4. Targets based upon environmental objectives of the *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992* for phosphorous, and *ANZECC guidelines (ANZECC & ARMCANZ 2000)* for slightly to moderately disturbed systems for total nitrogen, as presented in *Kelsey et al 2021.*

8.0 Definitions

Catchment	Is the area around the wetland or waterway that contributes surface run-off or groundwater to the wetland or waterway.
Catchment water quality	The quality of water in ground and surface waters of the Peel-Harvey Coastal Catchment (Figure 1) including drains, creeks, wetlands, rivers and estuarine areas. Water quality parameters include levels of phosphorus, nitrogen, organics, salinity, acidity and total suspended solids.
Catchment water quality improvement standards	The threshold levels of nutrients applied to land, or exported from land, as set in the Guidelines of this policy.
Closed system (as in closed system hydroponics)	Hydroponics system in which the nutrient solution is recirculated and the nutrient concentrations are monitored and adjusted accordingly. There is zero or minimal discharge of the solution or water to the environment.
Coastal catchment area	Same meaning as for *Peel-Harvey Coastal Plain Catchment*
Horticulture , irrigated agriculture **or** **'agriculture – intensive'**	Consistent with 'agriculture – intensive' in the Model Scheme Text, that being premises used for trade or commercial purposes, including outbuildings and earthworks, associated with the following — a. the production of grapes, vegetables, flowers, exotic or native plants, or fruit or nuts; b. the establishment and operation of plant or fruit nurseries; c. the development of land for irrigated fodder production; d. irrigated pasture (including turf farms); or e. aquaculture. Aquaculture is not covered by this Local Planning Policy.
Hydroponics	The process of growing plants using mineral nutrient solutions, without soil. Although hydroponic systems do not involve soil, they may involve a wide variety of growing media, such as perlite, gravel, peat, sand, rockwool and other.
In-ground horticulture	Horticulture where the plants are grown directly in the soil.
Land capability	Land capability refers to the ability of land to support a type of land use without causing damage. In south west of WA, land capability for agricultural land uses is assessed using DPIRD's published land evaluation standards[5].

Land suitability	Takes **land capability** information and other information (such as rainfall, environmental sensitivity) and determines the overall suitability of a piece of land to accommodate a particular kind of development. It is useful for site selection and can also underpin the manner in which a particular type of development is carried out, so that the environmental limitations or constraints are fully recognised. Phosphorus export hazard and proximity to receiving water are elements of land suitability in this policy.
Nutrient and Irrigation Management Plan	The plan prepared by the proponent to document how the production area and site will be managed over the lifespan of the operation to manage nutrient export and other aspects of the operation in relation to the natural resources. Reference?
Peel-Harvey Coastal Plain Catchment	The catchment area defined in *State Planning Policy 2.1 - Peel-Harvey Coastal Plain Catchment* and draft *State Planning Policy 2.9 – Planning for Water*
Production area	The area under crop production (excluding non-production areas on the Lot or Site)
Site	The lot or lots on which the production area is located.
Site specific soil survey	A detailed field-based survey of the soils and landforms at the proposed development site and collection of soil samples for laboratory testing. The results include a report on the soil types, a map of the soils and laboratory results. DPIRD's *A simple guide for describing soils*[6] sets out the minimum expectations for soil descriptions.
Soil-landscape systems of the Peel-Harvey Coastal Plain Catchment	Forrestfield System, Pinjarra System, Bassendean System, Vasse System, Spearwood System and Quindalup System
Viticulture or vines	The growing of grapes for wine or fruit; or growing of low yield olives.
Watercourse	A river, stream, creek or manmade drainage features in which water flows in a channel, whether permanently or intermittently (EPA, 2008b).
Wetland	Areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or artificial, fresh or saline (EPA, 2008b)

9.0 References

ANZECC & ARMCANZ 2000, *Australian and New Zealand guidelines for fresh and marine water quality*, Australia and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand.

Environmental Protection Authority 2008, *Environmental Guidance for Planning and Development,* Guidance Statement No. 33.

Environmental Protection Authority 1992, Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992, approved by Minister under section 31(d) of *Environmental Protection Act 1986, Government Gazette,* WA 5969 11 December 1992.

Fisher, S, 2022. *Ramsar 482 – our community protecting a Threatened Ecological Community*, Wetlands Australia Issue No. 35, Department of Climate Change, Energy the Environment and Water.

Hennig, K, Kelsey, P, Hall, J, Gunaratne, GG & Robb, M 2021 *Hydrological and nutrient modelling of the Peel-Harvey catchment*, Water Science Technical Series, report no. 84, Aquatic Science Branch, Department of Water and Environmental Regulation, Perth, Western Australia.

Stuart-Street, A, Short, N, Galloway, P & Schoknecht, N 2020, *A simple guide for describing soils*, Department of Primary Industries and Regional Development, Perth.

van Gool, D, Tille, P J, and Moore, G A. 2005, *Land evaluation standards for land resource mapping : assessing land qualities and determining land capability in south-western Australia*. Department of Primary Industries and Regional Development, Western Australia, Perth. Report 29

Appendix A: Suitability of soil-landscape mapping units for annual horticulture, perennial horticulture and viticulture

Table 1 provides advice from the Department of Primary Industries and Regional Development (DPIRD) on the potential suitability of mapped soil-landscape units in the (Insert local government name) for in-ground horticulture (Column 5). Mapping of soil-landscape units is available from (insert appropriate source for mapping).

The advice is based on two major assessments:

- The phosphorus export hazard associated with the soil-landscape unit (Column 3); and
- The land capability class rating of the soil-landscape unit for annual horticulture (A), perennial horticulture (P) and vines (V) (Column 4).
- DPIRD defines land capability as the ability of the land to sustain a specific land use without undesirable onsite or off-site effects. The essence of land capability assessment is a comparison of the biophysical requirements for a particular land use with the biophysical attributes (or qualities) of the land (Wells and King 1989).
- Land capability refers to the ability of land unit to support a type of land use without causing damage (Austin and Cocks, 1978).
- The assessments follow the methodology described in van Gool, D, Tille, P J, and Moore, G A. (2005), Land evaluation standards for land resource mapping: assessing land qualities and determining land capability in south-western Australia. Department of Primary Industries and Regional Development, Western Australia, Perth. Report 298. Weblink https://library.dpird.wa.gov.au/rmtr/280/

Proportional land capability categories (Column 4) are denoted in Table 2 using the following symbols: A1 A2, B1, B2, C1 OR C2. These symbols represent the following:

A1 More than 70% of the unit has high capability land (class 1 and 2)

A2 50-69% of the unit has high capability land (class 1 and 2).

B1 More than 70% of the unit has moderate or high capability land (class 1, 2 or 3)

B2 50-69% of the unit has moderate or high capability land (class 1, 2 or 3)

C1 50-69% of the unit has low capability land (class 4 and 5)

C2 More than 70% of the unit has low capability land (class 4 and 5).

Note: Land capability ratings are designed for broad-scale map units in which the availability of water resources for irrigation and the proximity to waterways has not been considered. Any on-site assessment should consider this.

Table 1: Nutrient export risk and suitability for in-ground horticulture in different land units of the Peel-Harvey Coastal Catchment

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
The **Forrestfield System (213Fo**) consists of undulating foot slopes of the Darling Scarp on colluvium over granitic and sedimentary rocks in the eastern margin of the Swan Coastal Plain. Soils include duplex sandy gravels, pale deep sands and grey deep sandy duplexes. Native vegetation is jarrah-marri forest and woodland.							
213Fo__F1a	Forrestfield F1a phase	1-15% lower slopes with well drained shallow to moderately deep, very gravelly acidic yellow duplex soils and common laterite.	Yes	B2	B2	B2	Yes, APV
213Fo__F1b	Forrestfield F1b phase	1-15% lower slopes with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	Yes	B1	B1	B1	Yes, APV
213Fo__F1c	Forrestfield F1c phase	1-15% lower slopes with well drained deep uniform yellowish brown sands which are generally free of laterite or gravel.	Yes	B1	A2	A2	Yes, APV
213Fo__F2a	Forrestfield F2a phase	Low slopes and foot slopes up to 5-10% with well drained shallow to moderately deep, very gravelly acidic yellow duplex soils and common laterite.	Yes	B1	B2	B2	Yes, APV
213Fo__F2b	Forrestfield F2b phase	Low slopes and foot slopes up to 5-10% with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	Yes	B1	A2	A2	Yes, APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Fo__F2c	Forrestfield F2c phase	Low slopes and foot slopes up to 5-10% slopes with well drained deep uniform yellowish brown sands which are generally free of laterite or gravel.	Yes	B1	B1	B1	Yes, APV
213Fo__F3	Forrestfield F3 phase	1-3% foot slopes with deep, imperfectly drained yellow and, less commonly, acidic gley duplex soils.	Yes	B1	B2	B1	Yes, APV
213Fo__F4	Forrestfield F4 phase	Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	No	C1	C2	C2	No
213Fo__F5	Forrestfield F5 phase	Poorly defined stream channels on lowest slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	No	C2	C2	C2	No
213Fo__Ff1	Forrestfield (D Range) F1 phase	Foot and low slopes < 10% with deep rapidly drained siliceous yellow brown sands, and pale or bleached sands with yellow-brown subsoil. Shrubland of unidentified species.	Yes	B1	A2	A1	Yes, APV
213Fo__Ff10	Forrestfield (D Range) F10 phase	Alluvial fans on lower slopes <5-10% with variable poorly drained soils.	No	C1	C1	C1	No
213Fo__Ff2	Forrestfield (D Range) F2 phase	Foot and low slopes < 10%.Well drained gravelly yellow or brown duplex soils with sandy topsoil. Woodland of Jarrah, Marri and some Bull Banksia.	Yes	B1	B1	B1	Yes, APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Fo__Ff3	Forrestfield (D Range) F3 phase	Foot and low slopes <10%. Well drained gravelly yellow or red duplex soils with sandy loam to loam topsoil. Woodland of Wandoo and Jarrah.	Yes	B1	A2	A2	Yes, APV
213Fo__Ff7	Forrestfield (D Range) F7 phase	Alluvial fans on slopes <5-10%.Variable, imperfectly drained soils comprising layers of sand, sandy loam, clay, grit and weathered granitic detritus. Low woodland of Marri, Candlestick and Bull Banksia and some Casuarina spp.	No	C1	C2	C1	No
213Fo__Ff9	Forrestfield (D Range) F9 phase	Seepage areas and non-incised drainage channels on foot slopes <3% with poorly drained bleached grey sands over an iron-organic hardpan.	No	B2	C2	B2	No
213FoW_SWAMP	Forrestfield wet, swamp phase	Swamp.	No	C2	C2	C2	No
213FoX_MINE	Forrestfield disturbed land, mine phase	Mine. Disturbed land.	No	C2	C2	C2	No
213FoX_URBAN	Forrestfield disturbed land, urban phase	Urban.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
The **Pinjarra System (213Pj)** consists of poorly drained coastal plains on alluvium over sedimentary rocks. Soils include semi-wet soils, grey deep sandy duplexes, brown loamy earths, pale sands and clays. Native vegetation is mainly jarrah-marri-wandoo-paperbark forest and woodland.							
213Pj__B1	Pinjarra, B1 phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	No	B1	B1	B1	No
213Pj__B1a	Pinjarra, B1a phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	Yes	B1	A2	A2	Yes, APV
213Pj__B2	Pinjarra, B2 phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 metres.	No	B1	B1	B1	No
213Pj__B2a	Pinjarra, B2a phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.	Yes	B1	A1	A1	Yes, APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__B3	Pinjarra, B3 phase	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.	No	C2	C2	C2	No
213Pj__B4	Pinjarra, B4 phase	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	No	C2	C2	C2	No
213Pj__B6	Pinjarra, B6 phase	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	No	C2	C2	C2	No
213Pj__P1a	Pinjarra P1a phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and generally not susceptible to salinity.	Yes	B2	C2	C1	Yes A
213Pj__P1b	Pinjarra P1b phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Moderately deep pale sand to loamy sand over clay: imperfectly drained and moderately susceptible to salinity in limited areas.	Yes	B2	C2	B2	Yes A V

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P1c	Pinjarra P1c phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Deep pale brown to yellowish sand to sandy loam over clay; imperfectly drained and moderately susceptible to salinity in limited areas.	Yes	B1	C2	B1	Yes A V
213Pj__P1d	Pinjarra P1d phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and moderately susceptible to salinity.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P1e	Pinjarra P1e phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over very gravelly clay; moderately well drained.	Yes	B1	B2	B1	Yes APV
213Pj__P2	Pinjarra P2 phase	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P2a	Pinjarra P2a phase	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam with a silcrete hardpan at 50-100 cm depth generally on top of an olive-grey clay.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P3	Pinjarra P3 phase	Flat to very gently undulating plain with deep, imperfect to poorly drained acidic gradational yellow or grey-brown earths and mottled yellow duplex soils, with loam to clay loam surface horizons.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P4	Pinjarra P4 phase	Poorly drained flats, sometimes with gilgai microrelief and with moderately deep to deep black, olive grey and some yellowish brown cracking clays and less commonly non-cracking friable clays with generally acidic subsoils.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P4a	Pinjarra P4a phase	Poorly drained flats. Cracking clays similar to P4 with a thin veneer of grey sand.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P5	Pinjarra P5 phase	Poorly drained flats, commonly with gilgai microrelief and with deep black grey to olive-brown cracking clays with subsoils becoming alkaline.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P5a	Pinjarra P5a phase	Poorly drained flats. Cracking clays similar to P5 with a thin veneer of grey sand.	Yes	C2	C2	C2	No Unless land capability constraints can be managed

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213PjSWP6a	Pinjarra P6a phase	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with major current river systems and larger streams. Acidic red and yellow duplex soils, less common.	Yes	A1	B1	A1	Yes APV
213PjSWP6b	Pinjarra P6b phase	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with prior stream deposits. Soils are uniform brownish sands.	Yes	B1	A2	A1	Yes APV
213PjSWP6c	Pinjarra P6c phase	Very gently undulating alluvial terraces and fans. Moderate to moderately well drained uniform friable brown loams, or well-structured gradational brown earths.	Yes	A1	B1	A1	Yes APV
213Pj__P7	Pinjarra P7 phase	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley sandy duplex and effective duplex soils.	No	C2	C2	C2	No
213Pj__P7a	Pinjarra P7a phase	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley duplex soils becoming alkaline with depth.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P7b	Pinjarra P7b phase	Seasonally inundated swamps and depressions or seepage areas near the base of the foothills with very poorly drained deep bleached siliceous sands.	No	C2	C2	C2	No
213Pj__P8	Pinjarra P8 phase	Broad poorly drained flats and poorly defined stream channels with moderately deep to deep sands over mottled clays; acidic or less commonly alkaline gley and yellow duplex soils to uniform bleached or pale brown sands over clay.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P9	Pinjarra P9 phase	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.	No	C2	C2	C2	No
213Pj__P9a	Pinjarra P9a phase	Generally shallow incised stream channels of minor creeks and rivers with poorly drained deep mottled yellow duplex soils, becoming alkaline with depth.	No	C2	C2	C2	No
213PjSW2	Sw2 - Swan, brown alluvial loams	Low level, occasionally flooded, alluvial terraces with imperfectly drained variable alluvial soils with loamy surfaces.	No	C2	C2	C2	No
213PjSWP10	Pinjarra P10 phase	Gently undulating to flat terraces adjacent to major rivers, but below the general level of the plain, with deep well drained uniform brownish sands or loams subject to periodic flooding.	Yes	B2	A2	A2	Yes APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213PjSWP10a	Pinjarra P10a phase	Flat terraces adjacent to major rivers with deep black cracking clays with alkaline subsoils; soils similar to P5.	No	C2	C2	C2	No
213Pj__P11	Pinjarra P11 phase	Shallow brown loamy soils or less commonly, very shallow sands over ironstone pavement which is a clear barrier to drainage.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P11a	Pinjarra P11a phase	Shallow sand to sandy loam over lateritic material; imperfect to moderately well drained.	Yes	C1	C2	C1	No Unless land capability constraints can be managed
213PjW_CLAYPAN	CP - Claypans (Pinjarra)	Claypan.	No	C2	C2	C2	No
213PjW_LAKE	Pinjarra wet, lake phase	Lake.	No	C2	C2	C2	No
213PjW_RIVER	Pinjarra wet, river phase	River.	No	C2	C2	C2	No
213PjW_SWAMP	Sw - Swamp (Pinjarra)	Swamp.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213PjX_MINE	Pinjarra disturbed land, mine phase	Mine. Disturbed land.	No	C2	C2	C2	No
The **Bassendean System (212Bs)** consists of sand dunes and sand plains with flats and swamps on sandy alluvium over sedimentary rocks. Soils include pale deep sand, semi-wet soil and wet soil. These soils have low fertility and are susceptible to leaching. In the Peel, these soils may become waterlogged because of high groundwater levels and may become flooded in some areas. Native vegetation is mainly banksia-paperbark woodlands and mixed heaths.							
212Bs__B1	Bassendean B1 phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	No	B1	B1	B1	No
212Bs__B1a	Bassendean B1a phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	Yes	B1	B1	B1	Yes, APV
212Bs__B2	Bassendean B2 phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey	No	B1	B1	B1	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
		sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 metres.					
212Bs__B2a	Bassendean B2a phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.	No	B1	A1	A1	No
212Bs__B3	Bassendean B3 phase	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.	No	C2	C2	C2	No
212Bs__B4	Bassendean B4 phase	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	No	C2	C2	C2	No
212Bs__B5	Bassendean B5 phase	Shallowly incised stream channels of minor creeks and rivers with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
212Bs__B6	Bassendean B6 phase	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	No	C2	C2	C1	No
212BsW_LAKE	Bassendean wet, lake phase	Lake.	No	C2	C2	C2	No
212BsW_SWAMP	Sw - Swamp (Bassendean)	Swamp.	No	C2	C2	C2	No
The **Spearwood System (211Sp)** consist of sand dunes and plains on windblown sand and limestone over sedimentary rocks in the western edge of the Swan Coastal Plain. Soils include yellow deep sands, pale deep sands and yellow/brown shallow sands. Native vegetation includes tuart-marri forest and woodland in south changing to heath and open woodland in north.							
211Sp__S1a	Spearwood S1a phase	Dune ridges with shallow to moderately deep siliceous yellow-brown sands, very common limestone outcrop and slopes up to 15%.	No	C2	C2	C2	No
211Sp__S1b	Spearwood S1b phase	Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%.	Yes	B1	B1	A2	Yes, APV
211Sp__S1c	Spearwood S1c phase	Dune ridges with deep bleached grey sands with yellow-brown subsoils, and slopes up to 15%.	No	B1	B1	B1	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
211Sp__S1d	Spearwood S1d phase	Dune ridges with moderately deep to very deep siliceous yellow-brown sands, rare limestone outcrop and slopes 3-20% occurring on the eastern slipface.	No	C2	C2	C2	No
211Sp__S2a	Spearwood S2a phase	Lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop.	Yes	B1	A1	A1	Yes, APV
211Sp__S2b	Spearwood S2b phase	Lower slopes (1-5%) of dune ridge with shallow to deep siliceous yellow-brown sands and common limestone outcrop.	Yes	B1	B1	A1	Yes, APV
211Sp__S2c	Spearwood S2c phase	Lower slopes (1-5%) of dune ridge with bleached or pale sands with a yellow-brown or pale brown subsoil (like S1c). Usually occurs on the eastern edge of the Spearwood Dunes.	Yes	B1	A1	A1	Yes, APV
211Sp__S3	Spearwood S3 phase	Inter-dunal swales and depressions with gently inclined side slopes and deep rapidly drained siliceous yellow-brown sands.	No	B1	A1	A1	No
211Sp__S4a	Spearwood S4a phase	Flat to gently undulating sandplain with deep, pale and sometimes bleached, sands with yellow-brown subsoils.	Yes	B1	A2	A1	Yes, APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
211Sp__S4b	Spearwood S4b phase	Flat to gently undulating sandplain with shallow to moderately deep siliceous yellow-brown and grey-brown sands with minor limestone outcrop.	Yes	B1	B1	A1	Yes, APV
211Sp__S4c	Spearwood S4c phase	Flat to gently undulating sandplain with deep, yellow-brown or dark brown siliceous sands that are seasonally inundated.	No	C2	C2	C2	No
211Sp__S6	Spearwood S6 phase	Flat stony plain with poorly drained shallow siliceous sands and large areas of bare limestone pavement.	Yes	C2	C2	C2	No
211SpW_LAKE	Spearwood wet, lake phase	Lake.	No	C2	C2	C2	No
211SpW_SWAMP	Spearwood wet, swamp phase	Swamp.	No	C2	C2	C2	No
211SpX_MINE	Spearwood disturbed land, mine phase	Mine. Disturbed land.	No	C2	C2	C2	No
The **Vasse System (211Va)** consists of poorly drained estuarine flats and swampy depressions of the Swan Coastal Plain. Soils include tidal flat soil, saline wet soil and pale deep sand. Native vegetation includes samphire, sedges and paperbark woodland.							

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
211Va__V1	Vasse V1 phase	Saline tidal flats composed of grey, black and brown foetid muds and humic sandy clays with locally common shell and limestone fragments.	No	C2	C2	C2	No
211Va__V2	Vasse V2 phase	Samphire covered sand and mud flats marginally higher than V1 and frequently inundated; with deep alkaline alluvial sands and clayey sands.	No	C2	C2	C2	No
211Va__V3	Vasse V3 phase	Sand flats marginally higher than V2. Frequently inundated; with deep alkaline alluvial sands and clayey sands, commonly supporting stands of Melaleuca spp.	No	C2	C2	C2	No
211Va__V4	Vasse V4 phase	Low level storm beach ridges and terraces with shallow to moderately deep uniform alkaline black sandy loams to loams overlying unconsolidated shell beds or clayey marl.	Yes	C1	C2	C2	No
211Va__V5	Vasse V5 phase	Upper level sandy terrace and gently undulating beach ridges with shallow to moderately deep grey siliceous sands overlying soft shelly limestone or shell beds.	Yes	B2	A2	A2	Yes, APV
211Va__V6	Vasse V6 phase	Upper level sandy terrace and gently undulating beach ridges with deep grey or bleached pale brown siliceous sands overlying soft shelly limestone.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
211Va__V6a	Vasse V6a phase	Gently undulating beach ridges similar to V6 but formed from reworked Pleistocene Bassendean sands. Deep bleached grey acidic siliceous sands with iron-organic hardpan.	No	C1	C2	C2	No
211Va__V7	Vasse V7 phase	Very broad shallow depression with deep, poorly drained, fine textured alkaline estuarine alluvium.	No	C2	C2	C2	No
211Va__V8	Vasse V8 phase	Flat poorly drained plains forming the margins of the estuarine deposits which border and partially overlie the Pinjarra Plain with variable, moderately deep to deep saline soils. Commonly, these are mottled yellow duplex soils.	No	C2	C2	C2	No
211Va__V9	Vasse V9 phase	Areas of former swamps which have been artificially drained, with uniform loamy or peaty sands.	No	C2	C2	C2	No
211VaW_LAKE	Vasse wet, lake phase	Lake.	No	C2	C2	C2	No
211VaW_SWAMP	Vasse wet, swamp phase	Swamp.	No	C2	C2	C2	No
The **Quindalup System (211Qu)** consists of coastal dunes with sand flats on wind-blown sand over sedimentary rocks on the western margin of the Swan Coastal Plain. Soils are mainly calcareous sands with native vegetation of mixed coastal scrub.							

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
211Qu__Qf2	Quindalup South Qf2 phase	Relict foredunes and gently undulating beach ridge plain with deep uniform calcareous sands.	Yes	B1	B1	B1	Yes, APV
211Qu__Qp1	Quindalup South Qp1 phase	Complex of nested low relief parabolic dunes with moderate to steep slopes and uniform calcareous sands showing variable depths of surface darkening.	No	C1	C1	C1	No
The **Murray Valleys System** (255Mv) consists of deeply incised valleys of the western Darling Range. Soils are mainly red loamy earths, shallow duplexes and rock outcrop. Native vegetation includes jarrah-marri-wandoo forest and woodland with mixed shrublands.							
255MvDR1	Murray Valleys DR1 phase	Gentle to moderate slopes of scarp face (5-25%) with red and yellow gradational earths and duplex soils with variable depth and common rock outcrop.	No	C2	C2	C2	No
255MvDR2	Murray Valleys DR2 phase	Gentle to moderately inclined slopes (3-20%) with red and yellow gradational earths and duplex soils with variable depth and common rock outcrop.	No	C1	C1	C1	No
255MvDR3	Murray Valleys DR3 phase	Deeply incised tributary valleys with slopes (<30%). Red and yellow gradational earths and duplex soils with variable depth and common rock outcrop.	No	C2	C1	C1	No

Appendix A: Suitability of soil-landscape mapping units for annual horticulture, perennial horticulture and viticulture

Table 1 provides advice from the Department of Primary Industries and Regional Development (DPIRD) on the potential suitability of mapped soil-landscape units in the (Insert local government name) for in-ground horticulture (Column 5). Mapping of soil-landscape units is available from (insert appropriate source for mapping).

The advice is based on two major assessments:

- The phosphorus export hazard associated with the soil-landscape unit (Column 3); and
- The land capability class rating of the soil-landscape unit for annual horticulture (A), perennial horticulture (P) and vines (V) (Column 4).
- DPIRD defines land capability as the ability of the land to sustain a specific land use without undesirable onsite or off-site effects. The essence of land capability assessment is a comparison of the biophysical requirements for a particular land use with the biophysical attributes (or qualities) of the land (Wells and King 1989).
- Land capability refers to the ability of land unit to support a type of land use without causing damage (Austin and Cocks, 1978).
- The assessments follow the methodology described in van Gool, D, Tille, P J, and Moore, G A. (2005), Land evaluation standards for land resource mapping: assessing land qualities and determining land capability in south-western Australia. Department of Primary Industries and Regional Development, Western Australia, Perth. Report 298. Weblink https://library.dpird.wa.gov.au/rmtr/280/

Proportional land capability categories (Column 4) are denoted in Table 2 using the following symbols: A1 A2, B1, B2, C1 OR C2. These symbols represent the following:

A1	More than 70% of the unit has high capability land (class 1 and 2)
A2	50-69% of the unit has high capability land (class 1 and 2).
B1	More than 70% of the unit has moderate or high capability land (class 1, 2 or 3)
B2	50-69% of the unit has moderate or high capability land (class 1, 2 or 3)
C1	50-69% of the unit has low capability land (class 4 and 5)
C2	More than 70% of the unit has low capability land (class 4 and 5).

Note: Land capability ratings are designed for broad-scale map units in which the availability of water resources for irrigation and the proximity to waterways has not been considered. Any on-site assessment should consider this.

Table 1: Nutrient export risk and suitability for in-ground horticulture in different land units of the Peel-Harvey Coastal Catchment

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
The **Forrestfield System (213Fo**) consists of undulating foot slopes of the Darling Scarp on colluvium over granitic and sedimentary rocks in the eastern margin of the Swan Coastal Plain. Soils include duplex sandy gravels, pale deep sands and grey deep sandy duplexes. Native vegetation is jarrah-marri forest and woodland.							
213Fo__F1a	Forrestfield F1a phase	1-15% lower slopes with well drained shallow to moderately deep, very gravelly acidic yellow duplex soils and common laterite.	Yes	B2	B2	B2	Yes, APV
213Fo__F1b	Forrestfield F1b phase	1-15% lower slopes with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	Yes	B1	B1	B1	Yes, APV
213Fo__F1c	Forrestfield F1c phase	1-15% lower slopes with well drained deep uniform yellowish brown sands which are generally free of laterite or gravel.	Yes	B1	A2	A2	Yes, APV
213Fo__F2a	Forrestfield F2a phase	Low slopes and foot slopes up to 5-10% with well drained shallow to moderately deep, very gravelly acidic yellow duplex soils and common laterite.	Yes	B1	B2	B2	Yes, APV
213Fo__F2b	Forrestfield F2b phase	Low slopes and foot slopes up to 5-10% with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	Yes	B1	A2	A2	Yes, APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Fo__F2c	Forrestfield F2c phase	Low slopes and foot slopes up to 5-10% slopes with well drained deep uniform yellowish brown sands which are generally free of laterite or gravel.	Yes	B1	B1	B1	Yes, APV
213Fo__F3	Forrestfield F3 phase	1-3% foot slopes with deep, imperfectly drained yellow and, less commonly, acidic gley duplex soils.	Yes	B1	B2	B1	Yes, APV
213Fo__F4	Forrestfield F4 phase	Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	No	C1	C2	C2	No
213Fo__F5	Forrestfield F5 phase	Poorly defined stream channels on lowest slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	No	C2	C2	C2	No
213Fo__Ff1	Forrestfield (D Range) F1 phase	Foot and low slopes < 10% with deep rapidly drained siliceous yellow brown sands, and pale or bleached sands with yellow-brown subsoil. Shrubland of unidentified species.	Yes	B1	A2	A1	Yes, APV
The **Pinjarra System (213Pj)** consists of poorly drained coastal plains on alluvium over sedimentary rocks. Soils include semi-wet soils, grey deep sandy duplexes, brown loamy earths, pale sands and clays. Native vegetation is mainly jarrah-marri-wandoo-paperbark forest and woodland.							

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__B1	Pinjarra, B1 phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	No	B1	B1	B1	No
213Pj__B1a	Pinjarra, B1a phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	Yes	B1	A2	A2	Yes, APV
213Pj__B2	Pinjarra, B2 phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 metres.	No	B1	B1	B1	No
213Pj__B2a	Pinjarra, B2a phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.	Yes	B1	A1	A1	Yes, APV
213Pj__B3	Pinjarra, B3 phase	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__B4	Pinjarra, B4 phase	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	No	C2	C2	C2	No
213Pj__B6	Pinjarra, B6 phase	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	No	C2	C2	C2	No
213Pj__P1a	Pinjarra P1a phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and generally not susceptible to salinity.	Yes	B2	C2	C1	Yes A
213Pj__P1b	Pinjarra P1b phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Moderately deep pale sand to loamy sand over clay: imperfectly drained and moderately susceptible to salinity in limited areas.	Yes	B2	C2	B2	Yes A V
213Pj__P1c	Pinjarra P1c phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Deep pale brown to yellowish sand to sandy loam over clay; imperfectly drained and moderately susceptible to salinity in limited areas.	Yes	B1	C2	B1	Yes A V

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P1d	Pinjarra P1d phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and moderately susceptible to salinity.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P1e	Pinjarra P1e phase	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over very gravelly clay; moderately well drained.	Yes	B1	B2	B1	Yes APV
213Pj__P2	Pinjarra P2 phase	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P2a	Pinjarra P2a phase	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam with a silcrete hardpan at 50-100 cm depth generally on top of an olive-grey clay.	No	C2	C2	C2	No
213Pj__P3	Pinjarra P3 phase	Flat to very gently undulating plain with deep, imperfect to poorly drained acidic gradational yellow or grey-brown earths and mottled yellow duplex soils, with loam to clay loam surface horizons.	Yes	C2	C2	C2	No Unless land capability constraints can be managed

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P4	Pinjarra P4 phase	Poorly drained flats, sometimes with gilgai microrelief and with moderately deep to deep black, olive grey and some yellowish brown cracking clays and less commonly non-cracking friable clays with generally acidic subsoils.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P4a	Pinjarra P4a phase	Poorly drained flats. Cracking clays similar to P4 with a thin veneer of grey sand.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P5	Pinjarra P5 phase	Poorly drained flats, commonly with gilgai microrelief and with deep black grey to olive-brown cracking clays with subsoils becoming alkaline.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P5a	Pinjarra P5a phase	Poorly drained flats. Cracking clays similar to P5 with a thin veneer of grey sand.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213PjSWP6a	Pinjarra P6a phase	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with major current river systems and larger	Yes	A1	B1	A1	Yes APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
		streams. Acidic red and yellow duplex soils, less common.					
213PjSWP6b	Pinjarra P6b phase	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with prior stream deposits. Soils are uniform brownish sands.	Yes	B1	A2	A1	Yes APV
213PjSWP6c	Pinjarra P6c phase	Very gently undulating alluvial terraces and fans. Moderate to moderately well drained uniform friable brown loams, or well-structured gradational brown earths.	Yes	A1	B1	A1	Yes APV
213Pj__P7	Pinjarra P7 phase	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley sandy duplex and effective duplex soils.	No	C2	C2	C2	No
213Pj__P7a	Pinjarra P7a phase	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley duplex soils becoming alkaline with depth.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P7b	Pinjarra P7b phase	Seasonally inundated swamps and depressions or seepage areas near the base of the foothills with very poorly drained deep bleached siliceous sands.	No	C2	C2	C2	No
213Pj__P8	Pinjarra P8 phase	Broad poorly drained flats and poorly defined stream channels with moderately deep to deep sands over mottled clays; acidic or less commonly alkaline gley and yellow duplex soils to uniform bleached or pale brown sands over clay.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
213Pj__P9	Pinjarra P9 phase	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.	No	C2	C2	C2	No
213Pj__P9a	Pinjarra P9a phase	Generally shallow incised stream channels of minor creeks and rivers with poorly drained deep mottled yellow duplex soils, becoming alkaline with depth.	No	C2	C2	C2	No
213PjSWP10	Pinjarra P10 phase	Gently undulating to flat terraces adjacent to major rivers, but below the general level of the plain, with deep well drained uniform brownish sands or loams subject to periodic flooding.	Yes	B2	A2	A2	Yes APV
213PjSWP10a	Pinjarra P10a phase	Flat terraces adjacent to major rivers with deep black cracking clays with alkaline subsoils; soils similar to P5.	No	C2	C2	C2	No

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Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
213Pj__P11	Pinjarra P11 phase	Shallow brown loamy soils or less commonly, very shallow sands over ironstone pavement which is a clear barrier to drainage.	Yes	C2	C2	C2	No Unless land capability constraints can be managed
The **Bassendean System (212Bs)** consists of sand dunes and sand plains with flats and swamps on sandy alluvium over sedimentary rocks. Soils include pale deep sand, semi-wet soil and wet soil. These soils have low fertility and are susceptible to leaching. In the Peel, these soils may become waterlogged because of high groundwater levels and may become flooded in some areas. Native vegetation is mainly banksia-paperbark woodlands and mixed heaths.							
212Bs__B1	Bassendean B1 phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	No	B1	B1	B1	No
212Bs__B1a	Bassendean B1a phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	Yes	B1	B1	B1	Yes, APV

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
212Bs__B2	Bassendean B2 phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 metres.	No	B1	B1	B1	No
212Bs__B2a	Bassendean B2a phase	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.	No	B1	A1	A1	No
212Bs__B3	Bassendean B3 phase	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.	No	C2	C2	C2	No
212Bs__B4	Bassendean B4 phase	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	No	C2	C2	C2	No
212Bs__B5	Bassendean B5 phase	Shallowly incised stream channels of minor creeks and rivers with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	No	C2	C2	C2	No

Soil-landscape mapping unit			Less than 50% of the map unit classed as High, Very High or Extreme Phosphorus Export Hazard?	Proportional Land Capability Category for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture? A=Annual P = Perennial V= Vines
Map Unit Symbol	**Map Unit Name**	**Map unit description**		Annual (A)	Perennial (P)	Vines (V)	
212Bs__B6	Bassendean B6 phase	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	No	C2	C2	C1	No