# Establishing Victoria's Ecological Infrastructure: Guidelines for Building Climate Future Plots





# **Design site layout: Planning**

Goals of the plot (Step1)

List of key people and responsibilities

Timeline of actions: including seed collection and/or plant ordering (e.g. Broadhurst et al 2016)

Evaluate likelihood of success in current conditions

#### Attributes of the site

- Access to water
- Topography
- Soil type and depth
- Hydrology and the hydrological regimes of the site
- Characteristic wind directions and speeds

Tube stock or direct seeding?

Influences site prep, timing and amount of seed 





b) Future proof remnant vegetation



c) Produce seed production area (SPA)

d) Carry out research



Broadhurst et al (2016)

# Site preparation

#### Weed control



#### Machinery for cultivation

### Pest animal control

# Fencing and plant guards



Minimum of livestock exclusion Highly desirable: time, effort and resources need to be protected Plant guards – needed? What type?



# **Basic Plot layout**



- Multiple provenances of a single species in a plot to mix genetic material
- 4-6 plants of each provenance in clumps within each plot to account for mortality and ease of monitoring
- Can include other local species within the same plot
- Replicate plots across site minimum of 4 times
- Better to have more replication of plots than more plants within each plot

Example of a component of a Climate Future plot for a Grey Box Grassy Woodland restoration in Central Victoria: includes replicated patches of *Eucalyptus macrocarpa* from three provenances (Bendigo, Wagga Wagga and Dubbo) as well as including species from other regions that are likely to persist well under future climate conditions (from Jordan and Hoffman 2017)









- Example: Climate ready revegetation at Nardoo Hills, central Victoria 2019-2020
- a) Compare the performance, from seedling to maturity, of four climate-adjusted

Figure 2. The map is an example of the plot layout within a block, in this case Block 12 and part of Block 13 provenances of each species against the local provenance

- b) Increase the woodlands genetic diversity and adaptation to a drying and warmer climate
  through tracking subsequent generations of trees
- c) Inform Bush Heritage management and the local community of future revegetation options

**BUSH HERITAGE** 

d) Encourage future collaborative research to extract maximum knowledge from this trial.

# **Provenance trials**

Peter Harrison

# Native distribution



1. Seed collections from different wild populations of a species (i.e. provenance)

- 2. Randomisation means that differences among provenances in mean performance has a genetic basis
- 3. Provenance performance used to estimate the extent to which provenances can be transferred



# Transfer functions







# **Research provenance plots**





TAS

Greening Australia

#### Connorville Hardman's North 2014

KEY: P *E.pauciflora* genetics BLUE markers/ PURPLE tree tags O E.ovata genetics WHITE markers/ WHITE tree tags CPO *E.pauciflora/E.ovata* genetics combination GREEN markers Alternating PURPLE and WHITE tree tags LO *E.ovata* local only ORANGE markers/ ORANGE tree tags 1—8 replicate number





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# Plant and provenance diversity



How many species and lifeforms with mixed provenances are you going to plant?

- Plant diversity should be quite high, depending on your EVC benchmark
- The number of lifeforms and the density of the plantings will depend on the EVC you are restoring
- A proportion of these 20 to 30 % should be of mixed provenance (see DELWP Revegetation Guidelines)

How many provenances and the proportion of provenance seed from outside of the local range you are using for each species?

- We recommend: 60 to 70 % local, 10 % wetter/cooler, 20 to 30 % hotter/drier analogues
- Maintain provenance identity of seed and seedlings throughout the propagation, transport and planting process

#### Note that mortality may be up to 30 to 40 % or higher after the first summer



# Plant and provenance diversity



How many species and lifeforms with mixed provenances are you going to plant?

- We suggest mixed provenance plantings of three to five species
- More complex research plots could consist of just one species with admixture provenancing
- Note that the use of other locally sourced species in provenancing plots may cause a competitive effect on the mixed provenance species
- How many provenances and the proportion of provenance seed from outside of the local range you are using for each species?
- The number of provenances used depends on the questions being asked
- We recommend the same proportion of local provenance seed to other provenances
- For genetics research we recommend collecting seed from up to 10 mother trees (families) per provenance and keep separate uniquely identified seedlots and seedlings





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# **Example: Dungrove provenance plots**









For CF plots e.g. out of 10 blocks: 6 local provenance 1 cool/wet 3 hotter/drier

Randomly allocate non local provenance blocks among the local so each replicate is different

- 2 TAS species *E.pauciflora* (widespread), *E.tenuriamis* (endemic)
- 10 paired provenances from altitudinal gradient including local
- 25 (5x5) trees per block, not individually pedigreed, 6 replicates
- Transported in labelled provenance boxes

# **Distances between plants and plots**

Spacings are important for site maintenance and monitoring We suggest leaving:

- 2.5 to 3 m between trees
- 2m or less for shrubs and grasses
- 6 m between replicate plot

Measuring, marking out and mapping provenance blocks and plots prior to planting improves accuracy and efficiency at planting time

Provenance trial planting Jericho, Tasmania

Tasmania







# **Plant labelling**



We recommend:

- labelling/barcoding of each individual plant (including family/provenance information) prior to planting
- sorting labelled plants in the nursery into their respective plots in separate plant trays: can speed up the planting process and improve accuracy
- planting designs be checked and plants measured immediately after planting

		SYMMONS PLAINS REP1					
Sec. 17 Jack		C1	C2	С3	C4 -	C5	C6
		A762	A410	A773	A701	A751	A788 —
	R6	12.6	7.8	22.3	7.1	2109	7.6
		—A692	A720	A402 —	A755	A714 -	A575 —
	R5	7.9	· [7.4	hondivitte	22.)	16.1	18.2
		A716	A688	A730 —	A705 -	A786	A777 🦳
	R4	12.4	9-0	9.6	19.)	10.9.	7.7
		A726	A756	A696	A384 —	A774 —	A768
1	R3	14-1	6.9	10.5	10-5	0.0	14.0
1		A381	A401	· A571	A725 —	A568 —	A758 —
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5		- A681	A590	A702 —	A376	A755	A710
	R1	8.8	19.1	265	21-2	12.5	12.0





## **Recording site characteristics**

List in Guidelines page 26

- Name and location of the trial, including GPS coordinates, scale of map and a North arrow.
- **Description of the landscape** being planted (for example, topography).
- Past land-use history, such as what the land was used for or issues with compaction.
- Use of long-lived chemicals and previous soil and pasture improvement
- Information gathered online (for example, from the Bureau of Meteorology website) on the mean annual rainfall and temperature at the site, including likely weather extremes (such as mean maximum temperature in the hottest month).
- Site preparation undertaken, planting techniques, whether guards were used and if the site was fenced and the presence of grazing animals.
- Total area of the planting site and number and size of the plots planted.
- Planting date and total number of plants planted.
- **Plot layout**, including the number of species and provenances used in each plot, the spacing between plants and plots, and the replicate, plot and treatment numbers (if relevant).
- Plot GPS coordinates



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