

ANNEXURE 1

Preliminary Environmental Impact Assessment Procedure – Clearing of Native Vegetation

Doc ID 592094-v2E	Custodian <i>Manager Environmental Impact Assessment and Approvals</i>
Version Date 16 November 2009	Accountabilities Framework Level 1 – Manage Environment
Next Review Date November 2011	Level 2 – Manage Environmental Approvals

1. Purpose

This document provides a procedure for Water Corporation's Environment Branch to conduct Preliminary Environmental Impact Assessment (PEIA) for Water Corporation projects proposing to clear native vegetation. The PEIA will determine any potential environmental aspects and impacts of Water Corporation maintenance, construction and infrastructure projects and whether approvals or further assessment is necessary and / or whether referral to State and / or Commonwealth regulators is required.

2. Scope

The PEIA for a proposed project will typically include the following:

- o Assessment to determine the key environmental aspects and impacts of a project proposing to clear native vegetation;
- o Assessment to determine whether proposed clearing associated with the project is exempt under the Environmental Protection Act 1986 (EPA Act) or the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Clearing Regulations) and whether a clearing permit is required;
- o Where a clearing permit is required, determine whether clearing can be carried out under an existing permit, or whether another permit is required;
- o Assessment of the project clearing activities against the Clearing Principles (EPA Act: Schedule 5);
- o Consultation with relevant stakeholders as required;
- o Assessment to determine whether the project clearing is likely to have a significant effect on the environment (e.g. clearing is likely to be at variance or seriously at variance with the clearing principles) and therefore may require supplementary environmental impact assessment (EIA) or referral to the Environmental Protection Authority (EPA);
- o Assessment to determine whether the project clearing will have a significant impact on any Matters of National Environmental Significance and therefore require referral to the Department of the Environment, Water, Heritage and the Arts (DEWHA); and
- o Record and report on the findings.

3. Definitions

Clearing is the killing of, removal of, severing or ringbarking of trunks or stems of, or the doing of any other substantial damage, including draining or flooding land, burning and grazing of stock, to some or all of the native vegetation in an area (Government of Western Australia, 1986). (*Clearing* does not include pruning of native vegetation, to the extent the pruning does not cause substantial damage to the native vegetation.)

Clearing Principles are the principles for clearing native vegetation set out in Schedule 5 of the EP Act (refer to Appendix 1).

Declared Rare Flora (DRF) are plant taxa declared by the Minister for the Environment under the Wildlife Conservation Act as "rare flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Declared plants cannot be disturbed without Ministerial approval. These plant taxa are categorised as either "Declared Rare Flora – Extant Taxa" or "Declared Rare Flora – Presumed Extinct Taxa" (not been collected, or otherwise verified, over the past 50 years despite thorough searching).

Environmental Offsets are beneficial activities undertaken to counterbalance an adverse environmental impact to achieve 'no net environmental loss' or aspirationally a 'net environmental benefit' (EPA, 2007).

Environmentally Sensitive Areas are defined areas having significant environmental value which have been declared in Regulation 6 of the Clearing Regulations.

Environmental Specialist means a person who is engaged by the permit holder for the purpose of providing environmental advice, who holds a tertiary qualification in environmental science or equivalent, and has experience relevant to the type of environmental advice that an environmental specialist is required to provide under Clearing Permit 185.

Environmental value means:

- (a) a beneficial use; or
- (b) an ecosystem health condition (as defined under Section 3 of the EP Act) (Government of Western Australia, 1986).

'Good' condition or better means that the vegetation is in either pristine, excellent, very good or good condition according to the Keighery scale (Keighery, 1994).

Native vegetation means indigenous aquatic or terrestrial vegetation but does not include vegetation that was intentionally sown, planted or propagated unless:

- (a) that vegetation was sown, planted or propagated as required under the EP Act or another written law; or
- (b) that vegetation is of a class declared by regulation to be included in this definition and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation (Government of Western Australia, 1986).

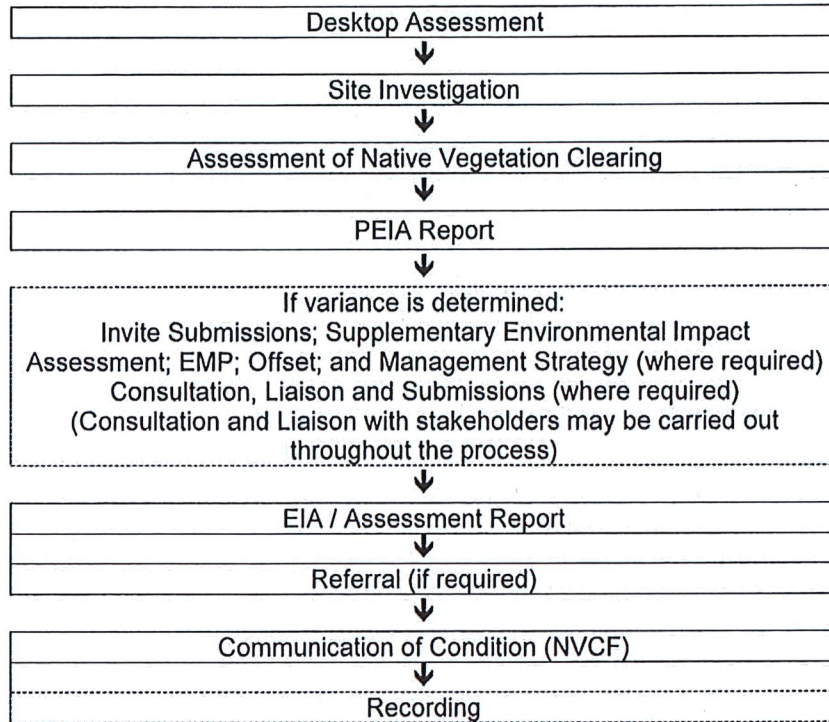
Priority Flora are plant taxa that have been designated a priority category as their threatened status is under review, particularly as knowledge of their distribution and threats are poorly known. The priority categories are:

- o Priority One - few, generally less than 5, populations which are under threat and primarily on lands not managed for conservation;
- o Priority Two - few, generally less than 5, populations with some that are not under immediate threat and are on conservation reserves;
- o Priority Three - several populations, with some that are not under immediate threat and are on conservation reserves; and
- o Priority Four - adequately surveyed and considered not immediately threatened but needs ongoing monitoring.

4. Procedure

4.1. Preliminary Assessment of Environmental Impacts

New projects typically involving the clearing of native vegetation undergo a three stage assessment process within the Water Corporation: 1) Planning Phase Assessment; 2) Internal Environmental Impact Assessment; and 3) Assessment under the 'Preliminaries to Works' protocol. The PEIA is carried out during the Internal Environmental Impact Assessment stage, and includes, but is not limited to, the following.



4.1.1. Desktop Assessment

Environmental aspects that are potentially relevant to the proposed project activities are assessed during a desktop assessment. This assessment includes, but is not limited to, the assessment of potential impact on or related to:

- Biodiversity Aspects (including but not limited to dieback and other diseases or pathogens (consultation with DEC), and weeds (including weeds declared under the *Biosecurity and Agriculture Management Act 2007*));
- Threatened and Protected Fauna Habitats;
- Threatened Flora (e.g. Declared Rare and Priority Flora);
- Threatened Ecological Communities (including relevant Matters of National Environmental Significance as defined by the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act));
- Vegetation Representation (i.e. current extent as compared to pre-European extent; Associations and Complexes);
- Watercourse or Wetland:
 - Conservation Category
 - Multiple-use
 - Resource enhancement
 - RAMSAR (Commonwealth)
 - Australian Nature Conservation Agency – Directory of Important Wetlands (Commonwealth)
 - Environmental Protection Policy (EPP) protected:
- Land Degradation (including Water Erosion, Soil Acidity, Soil Salinity, and Waterlogging);
- Conservation Areas (including adjacent buffer or linkage areas, Bush Forever, Land in Conservation Estate, Covenanted Lands);
- Groundwater:
 - Groundwater Dependent Ecosystems
 - Public Drinking Water Source Areas (PDWSA)
 - PDWSA Protection Advice (other advice)
 - Country Areas Water Supply Act Water Reserves;
- Surface waters / drainage; and
- Flooding.

4.1.1.1. Methodology

The Water Corporation's extensive spatial datasets (predominantly derived from and maintained by external government agencies), as well as other web based tools are searched and analysed (using GIS applications, including Water Corporation's Netmaps) to determine whether the project will impact areas with significant environmental value. The datasets are reviewed and updated regularly by the Water Corporation's Spatial Information Management Group.

Where dataset or web tool resources are unavailable, the relevant government agencies should be consulted for advice and assistance.

Where certain environmental aspects (detailed in Section 4.1.1) will potentially be significantly impacted, further assessment will be required (refer to Section 4.1.3.2).

4.1.2. Site investigation

Where further information regarding the project area (including its environmental value) is required, a site visit should be carried out by a Water Corporation Environmental Officer. Site visits will include an inspection of the proposed project area during which a basic vegetation assessment and identification of any potential impacts will be carried out. Photos of the project area and its surroundings should be taken. A Department of Environment and Conservation (DEC) officer may also be requested to participate in the site investigation if it is deemed that their specific site advice or clarification is required.

4.1.3. Assessment of Native Vegetation Clearing

4.1.3.1. Mitigation

If clearing of native vegetation is proposed, measures to mitigate the clearing should be addressed. The following principles should be followed as practicable:

- (a) avoid the clearing of native vegetation;
- (b) minimise the amount of native vegetation to be cleared; and
- (c) reduce the impact of clearing on any environmental value.

4.1.3.2. Assessment against the Clearing Principles.

The clearing proposed must be assessed against the Clearing Principles established in Schedule 5 of the EP Act (refer to Appendix 3 for clearing assessment report form). Each principle should be properly assessed in accordance with the DEC's Guide to the Assessment of Applications to Clear Native Vegetation.

Where clearing may be at variance with one or more of the clearing principles:

- (a) supplementary EIA (e.g. biological survey); will be required;
- (b) submissions must be invited from relevant stakeholders; and
- (c) an Environmental Management Plan (EMP) will be required.

(Refer below for further information)

Where clearing is likely to be or is at variance with:

- (a) one or more of the clearing principles, environmental offsets will likely be required, and/or
- (b) Clearing Principle 'g', 'i', and/or 'j' in particular, a Management Strategy pertaining to the relevant Clearing Principle(s) will be required.

(Refer below for further information)

Where clearing is or is likely to be seriously at variance with one or more of the clearing principles, consultation must be carried out with the DEC to confirm whether the clearing will be seriously at variance. If it is determined that the proposed clearing activity will be seriously at variance one or more of the clearing principles:

- (a) the proposed clearing activities will not be permitted under Clearing Permit CPS 185, and application for a separate (new) clearing permit will need to be made; or
- (b) the project may need to be referred to the EPA under Section 38 of the EP Act (a Section 38 referral form will need to be completed) for a level of assessment to be set (refer to Section 4.1.4). Advice should be sought from the EPA Service Unit during this process.

Invitation for Submissions

Where clearing of native vegetation may be or will likely be at variance with one or more of the clearing principles, submissions pertaining to the proposed clearing activities must be invited from, but not limited to, the following stakeholders.

- o DEC (Native Vegetation Conservation Branch)
- o DoAF (Office of the Commissioner of Soil and Land Conservation)
- o DoW (Drainage and Waterways Branch)
- o Conservation Council
- o LGA
- o Land owner or occupier
- o Any Environment, Community Group or other party that may have a reasonable interest in the proposed clearing activity.

Invitations should be sent in the form of a letter (refer to AQUA Doc. 949799). A period of 21 days must be allowed for submissions to be made. The letter should contain enough detail for the stakeholder to be able to determine and assess any relevant impacts. Prior to sending the letter, a courtesy phone call to each relevant stakeholder should be made explaining the proposed clearing activity and potential impacts.

Where required, supplementary information should be provided to relevant stakeholders (in particular the DEC and Conservation Council) to further describe the proposed clearing activity and to clarify any queries. This may be in the form of a presentation or meeting.

Written records of any consultation must be maintained.

Supplementary Environmental Impact Assessment

Following (or during) the PEIA, if it is determined that the proposed clearing activity may be or is likely to be at variance with one or more of the clearing principles, supplementary Environmental Impact Assessment (EIA) (e.g. biological surveys) pertaining to the relevant clearing principle(s), should be undertaken (e.g. by an external Consultants) to determine the significance of potential impacts and verify the variance status. Supplementary EIA should be carried out in accordance with the Water Corporation's *Scope of Works: Flora and Fauna Assessment*. Consultation with relevant stakeholders may also be carried out at this stage. The table below details a number of environmental factors that, if impacted, may trigger further assessment.

Environmental Factors	EP Act	EPBC Act	Supplementary EIA
Threatened Flora or Ecological Community	√	√	DEC database query + Flora Survey + Management Plan + Consultation with relevant agency (e.g. DEC or DEWHA)
Significant or Protected Fauna Habitat	√	√	DEC database query + Fauna Survey + Management Plan + Consultation with relevant agency (e.g. DEC or DEWHA)
Riparian Vegetation*	√		Flora Survey
Dieback Infected Area			DEC consultation + Dieback Survey + Management Plan

*Vegetation associated with artificial drains and drainage structures operated by Water Corporation is not considered to be riparian vegetation.

Environmental Management Plan

Where required, an Environmental Management Plan should be developed (either internally or externally) with regard to Water Corporation's *Drafting and Implementing Environmental Management Plans* and include:

- o a plan for managing the impacts;
- o a table setting out commitments to the EMP's requirements;
- o a program for monitoring compliance with commitments; and
- o a copy of the Revegetation Plan (if required).

Environmental Offsets

Environmental offset packages should be developed in consultation with the Environment Branch, Corporate Real Estate Branch and DEC and in accordance with the following offset principles:

- (a) direct offsets should directly counterbalance the loss of the native vegetation;
- (b) contributing offsets should complement and enhance the direct offset;
- (c) offsets are implemented only once all avenues to avoid, minimise, rectify or reduce environmental impacts have been exhausted;
- (d) the environmental values, habitat, species, ecological community, physical area, ecosystem, landscape, and hydrology of the offset should be the same as, or better than, that of the area of native vegetation being offset;
- (e) a ratio greater than 1:1 should be applied to the size of the area of native vegetation that is offset to compensate for the risk that the offset may fail;
- (f) offsets must entail a robust and consistent assessment process;
- (g) in determining an appropriate offset, consideration should be given to ecosystem function, rarity and type of ecological community, vegetation condition, habitat quality and area of native vegetation cleared;
- (h) the offset should either result in no net loss of native vegetation, or lead to a net gain in native vegetation and improve the condition of the natural environment;
- (i) offsets must satisfy all statutory requirements;
- (j) offsets must be clearly defined, documented and audited;
- (k) offsets must ensure a long-term (10-30 year) benefit; and
- (l) an environmental specialist must be involved in the design, assessment and monitoring of offsets.

Refer to the EPA's *Position Statement No. 9 Environmental Offsets* and *Guidance Statement No. 19 Environmental Offsets* for further guidance.

Management Strategy

Where required, a Management Strategy should be prepared by and environmental specialist, in Consultation with the Commissioner of Soil and Land Conservation. The Management Strategy should

include measures to avoid, mitigate or manage the land degradation (clearing principle 'g'), water quality deterioration (clearing principle 'l'), or flooding (clearing principle 'j') that triggered the requirement for a Management Strategy.

4.1.3.3. Requirements Prior to Clearing

Prior to clearing any native vegetation (in accordance with CPS 185), the following requirements must be adhered to:

- (a) Comply with the Assessment Procedure and the Assessment Principles set out in Clearing Permit CPS 185;
- (b) If an offset is required to be implemented, an offset proposal must be provided the CEO of the DEC for approval;
- (c) If a management strategy is required to be implemented, the management strategy must be provided the CEO of the DEC for approval; and
- (d) If revegetation and rehabilitation is required, a Revegetation Plan must be provided the CEO of the DEC for their record (unless the area to be revegetated and rehabilitated is: less than 0.5 hectares; not located in an ESA; and an area where the proposed clearing that triggers the obligation to revegetate and rehabilitate is not at variance with one or more of the clearing principles).

4.1.4. Referral to EPA (or DEWHA)

For projects where clearing of native vegetation:

- is not exempt;
- cannot be carried out under a clearing permit (e.g. clearing is seriously at variance with the clearing principles); or
- significantly impacts on areas of environmental value, referral to the EPA is likely.

Liaison with the EPA Service Unit will assist in determining whether referral is required. Where referral is required, a Section 38 referral form will need to be completed and submitted to the EPA for a level of assessment to be set.

For projects where clearing of native vegetation is likely to impact significantly on Matters of National Environmental Significance as established under the EPBC Act, referral to the DEWHA is likely. The DEWHA has developed a guideline that provides guidance on determining whether a proposed action is likely to have a significant impact on Matters of National Environmental Significance (guidelines can be found at the EPBC Act website).

4.2. Reporting

4.2.1. Preliminary EIA report

As part of the PEIA, a report (PEIA Report) (AQUA doc. 2169612) will be produced and will set out, but not be limited to, the following:

- project description;
 - Background (e.g. project planning and previous assessments)
 - Project area (e.g. location boundaries and maps)
 - Existing Environment (e.g. vegetation types / associations, condition and representation (current extent) of the vegetation to be cleared or impacted)
- the manner in which environmental impact mitigation has been carried out;
- the area (in hectares) and boundaries of clearing required for the project activity;
- findings of the desktop assessment;
- assessment of each of the clearing principles;
- whether there are likely to be any impacts that may be at variance or seriously at variance with the clearing principles;
- whether rehabilitation, revegetation, or an EMP is likely to be required;
- whether an environmental offset is likely to be required; and
- whether referral to EPA/DEWHA is recommended.

(A copy the report and other associated documentation produced in relation to the assessment of clearing impacts, must be maintained for record and audit purposes.)

4.2.2. EIA Report / Assessment Report

Where Supplementary Environmental Impact Assessment is required, a report (EIA Report) will be produced and will set out, but not be limited to, the following:

- o copies of any submissions received and a statement addressing each of those submissions;
- o the manner in which the permit holder has had regard to the permit holder's Procedure: Preliminary Environmental Impact Assessment Procedure – Clearing of Native Vegetation in conducting an EIA;
- o the results of any surveys and field assessments carried out;
- o any impacts likely to occur as a result of the clearing, including a description of those impacts that may be at variance or seriously at variance with the clearing principles;
- o any rehabilitation, revegetation, management strategy or other means of rectification that the permit holder will adopt to address the impacts; and
- o any offsets developed that will need to be implemented to address the impacts.

Where the permit holder conducts a PEIA and an EIA simultaneously, the permit holder may produce one report, to be known as an Assessment Report, which will contain all of the information required to be provided by this condition in a PEIA Report and an EIA Report. If an Assessment Report is developed, there is no need to produce a PEIA Report or an EIA Report for the proposed clearing.

(A copy the report(s) and other associated documentation produced in relation to the assessment of clearing impacts, must be maintained for record and audit purposes.)

4.3. Communication of Conditions (Native Vegetation Clearing Form)

Following the assessment of the proposed clearing and reporting, conditions pertaining to the specific clearing proposal will be communicated to the Clearing Proponent via the Native Vegetation Clearing Form (NVCF). The NVCF will contain only relevant conditions from Clearing Permit 185-1, as well other general conditions that will require addressing. The NVCF will be reviewed and signed-off by both Manager Environmental Impact Assessment and Approvals and the Clearing Proponent.

4.4. Records

Records associated with the PEIA in relation to the clearing of native vegetation will be maintained in AQUA, Water Corporation's corporate document and records management system, for record and auditing purposes, and will include the following:

- (i) a copy of any PEIA Report (and any associated documentation) produced;
- (ii) a map showing the location where the clearing occurred, recorded in ESRI Shapefile format;
- (iii) the area cleared (in hectares); and
- (iv) the date(s) of the clearing.

The following clearing activity information should be provided to Environment Branch by the Responsible Officer:

- o Location of cleared area, including GPS coordinates (GDA 94) of the cleared area (e.g. boundary) or map showing location of area cleared (GDA 94)
- o Size of the area cleared (ha);
- o Date the area was cleared;
- o Photos depicting area cleared (including the area prior to clearing) (where possible); and
- o Assessment Details (e.g. PEIA Report information) (where possible).

(These details should be entered into a AQUA for record and auditing purposes.)

To assist the tracking of conditional statutory approvals (i.e. any licence, permit or statement that allows an activity to be undertaken subject to legally binding conditions) and compliance recording, regulatory conditions imposed on project clearing activities will need to be forwarded to the Environment Branch Compliance Officer (RCMS Coordinator) to be entered into the Water Corporation's Regulatory Conditions Management System (RCMS). RCMS is based on the hierarchal level structure of the *approval*, the *conditions* of the approval, and the *actions* undertaken to substantiate compliance with each condition. For assistance using RCMS, refer to Water Corporation Guideline: Using the Regulatory Conditions Management System (RCMS).

5. Related Documentation

Australian Standard *Pruning of Amenity Trees* (AS 4373-1996)

Department of Environment and Conservation (2009), *Guide to the Assessment of Applications to Clear Native Vegetation* (Online). Perth, Western Australia.

Water Corporation's Guideline: Drafting and Implementing Environmental Management Plans

Water Corporation Guideline: Using the Regulatory Conditions Management System (RCMS)

Water Corporation Scope of Works: Flora and Fauna Assessment

6. References

Environmental Protection Authority (2007). *Environmental Offsets: Draft Guidance Statement No 19*, Perth, Western Australia, June 2007.

Environmental Protection Authority (2006). *Environmental Offsets: Position Statement No. 9*. Perth, Western Australia, January 2006.

Government of Western Australia (2004). *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Government of Western Australia (1998a). *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

Government of Western Australia (1998b). *Environmental Protection (Swan and Canning Rivers) Policy 1998*.

Government of Western Australia (1992a). *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.

Government of Western Australia (1992b). *Environmental Protection (Peel Inlet - Harvey Estuary) Policy 1992*.

Government of Western Australia (1992c). *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*.

Government of Western Australia (1986). *Environmental Protection Act 1986*.

Keighery, B.J. (1994). *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc). Nedlands, Western Australia.

Manager Environment
16 November 2009

Document Revision History

21 Feb 2008	Original version
16 Nov 2009	Amended version

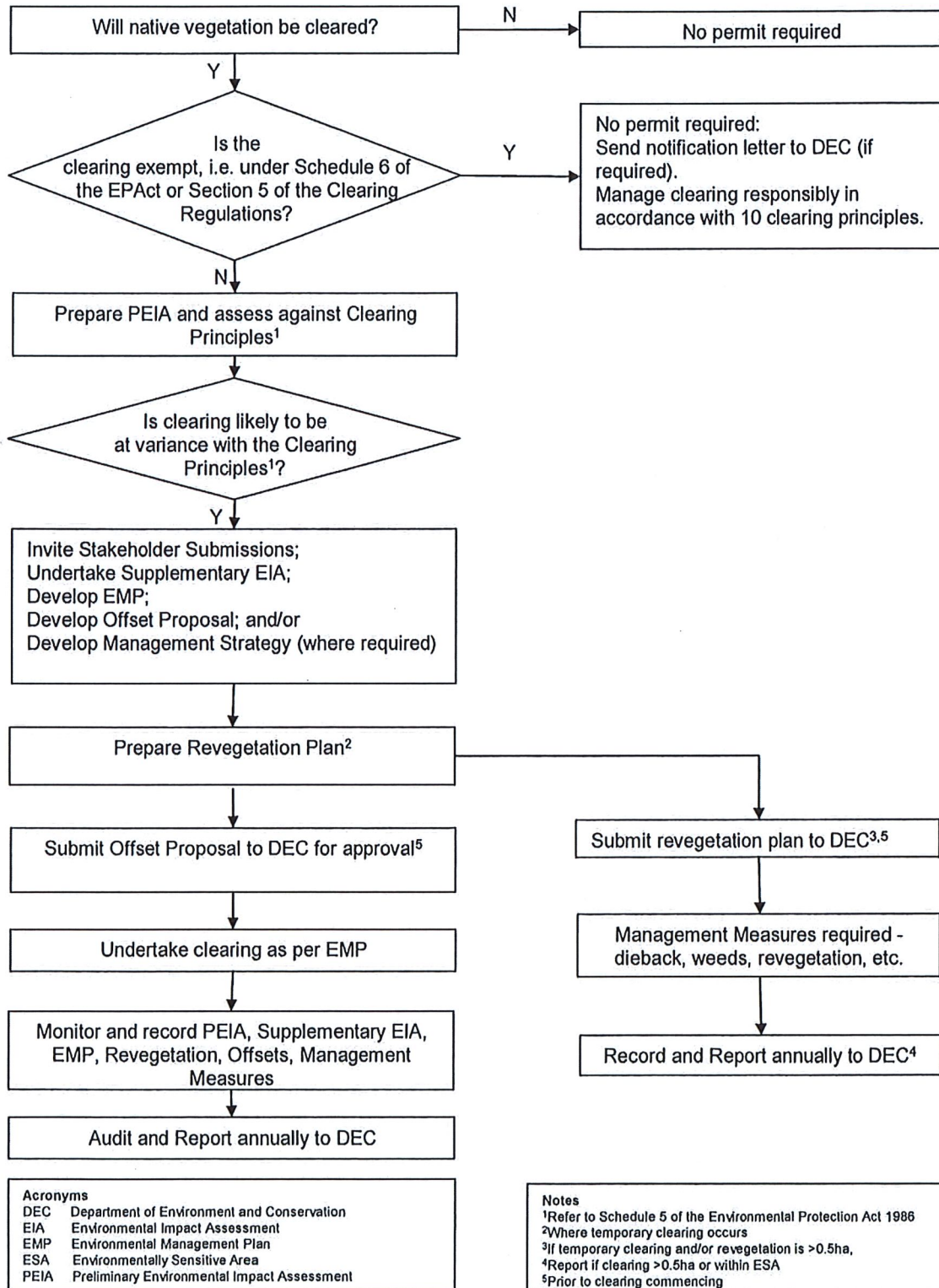
Appendix 1: Clearing Principles

Native vegetation should not be cleared if:

- (a) it comprises a high level of biological diversity;
- (b) it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
- (c) it includes, or is necessary for the continued existence of, rare flora;
- (d) it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;
- (e) it is significant as a remnant of native vegetation in an area that has been extensively cleared;
- (f) it is growing in, or in association with, an environment associated with a watercourse or wetland;
- (g) the clearing of the vegetation is likely to cause appreciable land degradation;
- (h) the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
- (i) the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or
- (j) the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

(Ref: Schedule 5 of the Environmental Protection Act 1986)

Appendix 2: Native Vegetation Clearing Process Flow Chart



Acronyms

DEC	Department of Environment and Conservation
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESA	Environmentally Sensitive Area
PEIA	Preliminary Environmental Impact Assessment

Notes

¹ Refer to Schedule 5 of the Environmental Protection Act 1986
² Where temporary clearing occurs
³ If temporary clearing and/or revegetation is >0.5ha,
⁴ Report if clearing >0.5ha or within ESA
⁵ Prior to clearing commencing

(Ref: PM#2366468vR - Preliminary Environmental Impact Assessment Procedure - Clearing of Native Vegetation - Flowchart.ppt.PPT.DRF)

Appendix 3: Vegetation Clearing Assessment Report

(This report template is an example and has been prepared to assist Water Corporation in addressing "Assessment of Clearing Impacts" and is based on the DEC's template. For guidance on how to complete the form, refer to DEC completed reports (active permits) at https://secure.dec.wa.gov.au/cps_reports/.)

AREA UNDER ASSESSMENT DETAILS

Proponent details

Proponent's name: Water Corporation

Contacts: Name:

Phone:

Fax:

Email:

Property details

Property:

Colloquial name:

Area under assessment

Clearing Area (ha)	No. Trees	Method of Clearing	For the purpose of:	Site Plan Attached
				<input type="checkbox"/> Yes <input type="checkbox"/> No

Avoidance/Minimise clearing

How have the clearing impacts been minimised?

BACKGROUND

Existing environment and information

Description of the native vegetation under application

(Vegetation Condition can be determined using - Keighery, B.J. (1994) Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc). Nedlands, Western Australia.)

Site Visit Undertaken	<input type="checkbox"/> Yes <input type="checkbox"/> No	Fauna / Flora Survey Undertaken	<input type="checkbox"/> Yes <input type="checkbox"/> No
Site Report Attached	<input type="checkbox"/> Yes <input type="checkbox"/> No	Fauna / Flora Survey Report Attached	<input type="checkbox"/> Yes <input type="checkbox"/> No
Site Photos Attached	<input type="checkbox"/> Yes <input type="checkbox"/> No	Other Relevant References Attached	<input type="checkbox"/> Yes <input type="checkbox"/> No

Vegetation Complex	Clearing Description	Vegetation Condition	Comment
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ASSESSMENT OF APPLICATION AGAINST CLEARING PRINCIPLES

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.
Comments Proposal is XXXXXXXXX variance to this Principle

Methodology

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Comments Proposal is XXXXXXXX variance to this Principle

Methodology

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Comments Proposal is XXXXXXXXX variance to this Principle

Methodology

(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Comments Proposal is XXXXXXXXX variance to this Principle

Methodology

Planning instrument, Native Title, RIWI Act Licence, EP Act Licence, Works Approval, Previous EPA decision or other matter.

Comments

Methodology

SUBMISSIONS

If required have submissions been requested and addressed

Submission Requested from	Request Sent (Date)	Submission Received (Date)	Issues Raised / Comments Made
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ASSESSOR'S RECOMMENDATIONS

List of Principles seriously at variance, at variance or maybe at variance

Recommendation (does this clearing require a Revegetation Management Plan / Offset Proposal / Environmental Management Plan / Management Strategy/New Application, under CPS 185/1)

References


OFFICER PREPARING REPORT

Position: _____
 Title
 XXXXXXXXX Regional Office/Approvals Branch
 Water Corporation
 Phone

 Date

ANNEXURE 2

Revegetation Guideline – Techniques and Monitoring

 <p>WATER CORPORATION ABN 78 692 434 917</p>	<h2>Revegetation Guideline – Techniques and Monitoring</h2>
<p>Doc ID 592092-v2</p>	<p>Custodian Manager, Environmental Operations</p>
<p>Version Date 21 May 2009</p>	<p>Accountabilities Framework Level 1 – Manager Environment</p>
<p>Next Review Date May 2011</p>	<p>Level 2 – Manager Environmental Compliance</p>

1. Purpose

Biodiversity can be affected by the Water Corporation's activities, particularly through its management of land and asset development. The Water Corporation aims to protect and enhance biodiversity on land under its influence and is committed to avoiding or minimising adverse impacts on biodiversity (Water Corporation Policy: *Biodiversity Policy*).

This Guideline covers establishment of native vegetation in disturbed areas, particularly where native vegetation has been cleared. It is designed to guide Water Corporation employees, but not replace specialist advice regarding revegetation projects.

2. Scope

Rehabilitation normally comprises two stages:

- Landform design and reconstruction of a stable land surface; and
- Revegetation on the reconstructed landform.

This guideline focuses on the revegetation stage and subsequent monitoring and maintenance requirements following revegetation.

This document addresses the following areas:

- The importance of revegetation;
- Key issues in the planning, implementation and ultimate success of revegetation works;
- The steps involved in the management of revegetation works; and
- Supporting technical information about revegetation techniques.

This document should be used by Water Corporation employees who are involved with the planning and implementation of revegetation works, including, but not limited to:

- Project Managers;
- Asset and Contract Managers;
- Operation Managers;
- Contract Managers; and
- Environmental Officers.

3. Definitions

Biodiversity	The variety of all life forms - the different plants, animals and micro-organisms, the genes they contain, and the ecosystems of which they form a part. (Commonwealth of Australia, 1996).
Direct Seeding	A method of re-establishing vegetation through the establishment of a seed bed and the introduction of seeds of the desired plant species.
Planting	The re-establishment of vegetation by creating favourable soil conditions and planting seedlings of the desired species.
Provenance	Used to refer to seed collected from a natural population. Provenance is also used to describe patterns of genetic variation exhibited by a species over its geographic range (Mortlock, 1999).
Regeneration	Revegetation that can be established from <i>in situ</i> seed banks contained either within the topsoil or seed-bearing mulch.

Rehabilitation	A process where disturbed land is returned to a stable, productive and self-sustaining condition, taking future land use into account (this process differs from the narrower definition of restoration by not aspiring to fully replace all of the original components of an ecosystem) (EPA, 2006).
Restoration	The process of fully repairing the composition, structure, function and dynamics of pre-existing indigenous ecosystems (EPA, 2006).
Revegetation	The re-establishment of a cover of native vegetation in an area such that the species composition, structure and density is similar to pre-clearing vegetation types in that area, and can involve regeneration, direct seeding and/or planting.
Site Preparation	Management of existing site topsoil and preparation of the finished soil surface, for example by ripping or tilling the soil surface and resspreading site topsoil and chipped native vegetation.

4. Revegetation and Monitoring Guideline

4.1. Introduction

Water Corporation's development of infrastructure can result in the clearing of some native vegetation. Clearing of native vegetation can lead to degradation of soils and water resources, raised water tables and salinisation, release of greenhouse gases and decline and loss of biodiversity. Where practical, revegetation is therefore important, either through natural regeneration or strategic replanting programs. Good planning and environmental management will minimise the impacts of clearing on the environment and aid in the preservation of biodiversity through re-establishment of habitats and corridors for native species

Successful revegetation requires good planning well in advance of any physical activities (refer to [Section 4.2.2](#)). It is important that site constraints and project commitments are identified and responded to.

4.2. Considerations

4.2.1. Establishing Objectives

A clear objective for a revegetation project should be defined. Revegetation is undertaken for a variety of purposes including:

- to enhance existing native vegetation;
- to enhance rare or threatened species or plant communities;
- to stabilise soil;
- to reduce or control salinity;
- to manage pests, for example, attracting native birds to control insects; as habitat for native wildlife;
- to act as a sink for greenhouse gases;
- to improve water quality;
- to improve the amenity around homes and buildings; for aesthetic reasons, for example, screening unwanted views; and
- to create a pleasant living and working environment; for social and educational purposes.

As a minimum, the revegetation should be stable and on-going maintenance of the established vegetation should be minimal.

The design of the revegetation, including the species chosen, their placement, densities, the shape and size of the works, should reflect the objectives of the revegetation. If multiple outcomes are intended, there are likely to be different requirements to consider in the design of the works. For example, if the primary goal is to enhance biodiversity, the plant species, their arrangement and the width and length of the revegetation will be quite different to establishing vegetation for aesthetics purposes.

For projects that have been subject to statutory assessment by the Environmental Protection Authority (EPA), specific objectives will be set. Constraints may be applied, for example, on plant species selection, seed collection and propagation. The Project or Asset Manager may also set revegetation objectives. Goals and targets for revegetation must be realistic for the location and project (refer to [Section 4.5.1](#)). When establishing an objective, it is important that sufficient resources are allocated to the project budget (refer to [Section 4.2.2](#)) in order for rehabilitation aims to be met.

4.2.2. Planning

Successful projects have good planning. Projects that involve establishing native vegetation are no exception. Careful planning helps to set objectives, identify tasks to be done, ensures that the resources are available and that activities are undertaken when needed. Planning ensures that the best possible results can be achieved.

Planning should be carried out well in advance of any physical activities. Effective revegetation means identifying and responding to the site constraints (e.g. weeds) and project commitments. Planning should involve making the best use of the materials available on site, such as not wasting the existing soil and vegetation resources. A comprehensive Revegetation Plan (refer to [Section 4.3](#)) detailing how an area of land should be revegetated and what the final land use will be should be established as early as possible in the development of a project.

The key steps in revegetation are detailed below:

- Site assessment;
- Preliminary Planning (including setting of objectives);
- Development of a Revegetation Plan;
- Site Preparation;
- Weed and Pest Management;
- Seed collection, propagation and/or acquisition;
- Implementation;
- Vegetation establishment; and
- Monitoring and maintenance (especially on-going weed and pest control).

4.2.2.1. Timing

Timing is a key consideration throughout the whole process of establishing vegetation. Identifying the appropriate timing in your area for seed collection, site preparation, seeding and planting for the species and site conditions involved is essential.

The timing of seeding and planting is site specific and heavily dependent on thorough weed control and soil moisture conservation. Ideally, seeding or planting should be undertaken when the soil has wetted up and temperatures are still reasonably warm. This would normally be immediately prior to or at the 'break of season' (i.e. after winter rains have started). Thorough weed control will often widen the 'window-of-opportunity' for planting or seeding. As seasons can be variable, having preparation completed well in advance enables revegetation to occur when the conditions are most favourable. Soil preparation should occur by April (for the majority of regions).

The following table is a guide for the timing of activities in areas of medium to high rainfall and semi-arid environments. The timing of the activities should still be tailored to the local environmental conditions. It is recommended that planning, and in some cases preparatory on-ground works, such as seed collection, plant acquisition and weed control, begin more than a year before seeding or planting.

Activity	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
1. Planning*									
2. Preparing the ground									
Soil preparation									
Weed control*									
3. Pest animal management									
Pest control									
Fencing									
4. Seeds and seedlings									
Seed collection, cleaning and ordering*									
Plant orders and propagation*									
5. Revegetation									
Natural regeneration									
Direct seeding and planting									
6. Maintenance									
7. Monitoring									

Refers to the timing of activities for both semi-arid and medium to high rainfall environments

Refers to medium to high rainfall (500mm plus p.a.) areas only

Refers to northern Midwest and North West regions areas only

*These activities should commence in advance of the seasons shown. Ideally:

- begin planning two or more years ahead of seeding or planting;
- start weed control at least twelve months prior to seeding or planting or earlier depending on the site;
- order seed two years before seeding or planting; and
- order plants at least twelve months prior to planting.

4.2.2.2. Site Assessment

A site assessment will assist to determine a number of site characteristics, including but limited to, slope, species diversity, weed and disease issues, stockpiling requirements, and revegetation techniques to be used and will allow for more effective planning of revegetation works. Where possible, relevant stakeholders (e.g. Project Managers, Environment Officers (preferably with botanical experience), and Revegetation Contractors) should meet on site to discuss possible constraints and assess opportunities. The table below provides a checklist of things to note when conducting your site assessment.

Site assessment checklist	
Flora and fauna	<ul style="list-style-type: none"> ✓ Native vegetation ✓ Weeds ✓ Native wildlife (or evidence of) ✓ Introduced animals and birds (or evidence of)
Soils	<ul style="list-style-type: none"> ✓ Type of soil/s, structure and health
Other features	<ul style="list-style-type: none"> ✓ Topography and contours ✓ Aspect ✓ Wetlands, creeks, drainage lines, ridges, escarpments etc.
Land and water issues	<ul style="list-style-type: none"> ✓ For example, erosion by wind or water; salinity
Infrastructure above and below ground	<ul style="list-style-type: none"> ✓ Dams, bores, buildings, roads, easements, powerlines, underground cables/pipes etc.

Site assessment checklist		
Access	✓	People, vehicles and machinery. The level of access available will influence the revegetation techniques chosen and the transport of materials, such as plants, across the site.
Surrounding landscape	✓	What is surrounding the site that will have positive and negative effects on the revegetation?

4.2.3. Budget Considerations

A detailed budget must be developed that includes funds for activities prior to (e.g. weed control, seed collection and propagation and soil preparation), during (vegetation establishment) and following the revegetation works (on-going monitoring and maintenance (inc. weed and pest control)). Projects will vary in cost depending on size, location and project characteristics. It is important to note that certain aspects, e.g. weed and pest control must be considered throughout the revegetation program. Such aspects are often overlooked and can lead to failed revegetation programs.

4.2.4. Engagement of Consultants and Contract Arrangements

Pre-qualified environmental consulting service providers can be engaged via the Environmental Consultants Panel. For more information regarding the engagement of a consultant via the Environmental Consultants Panel, please refer to the Water Corporation's user guide *Panel for the Provision of Environmental Consulting Services* located on the [Procurement Branch's website](#).

Contract arrangements should include a Revegetation Scope of Works, detailing specific requirements of works, including establishment of the new vegetation as well as any remedial works, monitoring requirements and contract arrangement for ongoing site management, that may be necessary to assure the project objectives will be met. The specific arrangements must be based on an assessment of project risks. For assistance developing a scope of works, please contact the Environment Branch.

4.2.5. Regional Differences

Revegetation requirements will differ across the State, with climate being a large factor in determining these requirements. Climate can and should influence the timing of revegetation activities as well as the revegetation method used. Historically in the more arid areas, (i.e. where rainfall is low and rainfall variability is moderate to high) the most cost effective method has proven to be topsoil management (refer to [Section 4.4.1](#)) along with some direct seeding and allowing natural regeneration to occur. Planting is generally limited to the Southwest corner of the State where annual rainfall is relatively high and reliable.

4.3. Revegetation Plan

A Revegetation Plan should be developed by the specialist consultant/contractor engaged to carry out the revegetation works. The plan should define the scope and extent of the works and the methods to cost effectively deliver the works. An initial site assessment will be necessary to determine relevant site conditions, constraints and requirements.

Ideally, the Revegetation Plan should include:

- A project outline;
- Layout and Site Description;
- Site Preparation Techniques;
- Weed (and other pest - where required) Control Measures and Recommendations (pre installation and post installation);
- Recommended Species List and source details (seed mix and/or seedlings selection to be determined by contractor);
- Revegetation Techniques – i.e. regeneration, direct seeding or planting details (inc. an optimal timing, planting locations, densities, etc.);
- Vegetation Establishment Period;

- Revegetation Completion (success) Criteria;
- Ongoing Monitoring and Maintenance Program and methodology;
- Implementation Schedule/Timeline (e.g. a timetable/Gantt chart displaying when the revegetation activities are proposed to occur (e.g. site preparation in xx month of xx year, weed control 12 months prior to planting, during establishment and after planting for xx years; monitoring in xx month/s for xx years, etc.); and
- Project limitations and issues.

4.4. Site Management

4.4.1. Topsoil Management

Topsoil from areas being cleared should be retained for subsequent site rehabilitation as it typically contains most of the seeds and other plant propagules (e.g. rhizomes, lignotubers, roots etc.), important micro organisms, organic matter and plant nutrients.

Two areas of importance when dealing with topsoil are depth of stripping and duration of storage. As the seed bank predominantly occurs within the top few centimetres of topsoil, shallow ripping (e.g. <100mm) is recommended. Double stripping techniques can also aid in improving the success of rehabilitation. Double stripping involves the removal of the top 100mm of soil and the then the removal of the next 300mm of soil, placing them in different stockpiles and re-using them in the appropriate order, to cover new rehabilitated sites.

While fresh topsoil is clearly preferable to optimise revegetation outcomes, temporary stockpiling of topsoil may be unavoidable. Stockpiling of topsoil can reduce its quality. Stockpiles can become anaerobic, organic matter and nutrients may be lost, seeds deteriorate, other plant propagules die and populations of beneficial soil micro-organisms are reduced significantly. Seeds of species that don't have hard coats are particularly susceptible to loss during stockpiling.

Where stockpiling is unavoidable, it should be for the least time possible and should be:

- as low as possible with a large surface area – 2m high or less;
- stabilised with vegetation or other soil stabilisers to protect from erosion, weeds etc. if the stockpiles are expected to be required for more than a few months before reuse; and
- located where they will not be disturbed.

The timing of topsoil removal is important. Clearing and soil removal should be carried out after seed set, where possible, to maximise the stores of seed in the soil. For example, in the jarrah forest, topsoil should be collected in summer when the seed bank is at its highest. Soil should not be removed or spread when it is too wet or too dry, as this can lead to compaction, loss of structure and loss of viability of seed. Ripping and mound ploughing (if wet) are common methods used to improve the success of revegetation through the alleviation of compaction and the establishment of a seed bed (refer to [Section 4.4.3.1](#)).

4.4.2. Revegetation Methods

4.4.2.1. Species Selection and Collection

Species selection will depend on the future land use, soil conditions and climate and should be consistent with the revegetation objectives and a baseline flora survey carried out (a baseline flora survey should be carried out prior to any clearing activities to determine the pre-clearing vegetation characteristics at the site). In some instances, species selection may be subject to statutory requirements. As a minimum, the species should include the most common local trees and shrubs matched with soil type. Where revegetation is carried out in areas of conservation importance, species establishment should include as many of the locally-occurring species as possible. Where possible, as much seed as possible should be collected from areas proposed for clearing (prior to any clearing being carried out) and neighbouring areas. This will ensure the seed stocks are of local provenance.

Not all native species successfully establish in areas that have been altered. If this is the case, and the objective is to re-establish vegetation as closely as possible to the original native

vegetation, then species from outside the project area may need to be introduced. Species that have similar growth forms to the original vegetation and grow well in comparable soils will be most appropriate. Care should be taken to avoid introducing a species that could become a fire hazard, invade surrounding areas of native vegetation or become weeds.

Most species used in revegetation works will be locally-occurring provenance native plants. Native plants, and particularly locally-occurring species, are preferable over other species because of:

- their generally better survival and growth in the local environment;
- reduced likelihood of becoming invasive;
- their indirect and direct biodiversity value (inc. suitability to local fauna); and
- their contribution to a local 'sense of place'.

Particular species can be identified from site-specific flora surveys (ideally carried out in spring) or from various other sources including:

- local knowledge of revegetation contractors and botanists, and regional staff within the Departments of Agriculture and Food and/or Department of Environment and Conservation; and
- various databases.

4.4.2.2. Seeding Methods

Regeneration from topsoil

Revegetation outcomes can be achieved through management of existing seed banks or the use of seed banks contained within topsoil maintained from the site or 'grafted' from elsewhere. *In situ* seed banks can be used where the topsoil is largely intact and weed seed numbers are low. Regeneration can be encouraged by scarification (loosening the top few centimetres) of the soil. This method may be particularly suitable for very small areas.

Where regeneration from existing topsoil alone will be inadequate, it might be possible to apply a fresh topsoil containing seed of target plant species. Within reason, topsoil can be spread more thinly when reapplied to cover a larger area than originally stripped.

When regenerating from topsoil, the potential for the introduction of weeds and dieback infection should be addressed (refer to [Section 4.4.3.4](#) and [Section 4.4.3.5](#) respectively).

Direct seeding

Direct seeding involves distributing seed directly onto sites that have been suitably prepared to encourage germination and growth. In the more arid parts of the State, successful establishment can be expected to take longer and be less reliable.

Natural regeneration or direct seeding from topsoil is the preferred approach for all regions of the state where re-establishment of 'natural' vegetation is the objective. This may be supplemented by some planting. Generally, planting alone is not preferred.

Planting

While direct seeding can be carried out in any part of the State, tree and shrub planting is most likely to be successful in those areas that experience reliable rainfall. This restricts planting without irrigation to the south-west corner of the State.

Where establishment of self-sustaining native vegetation is the aim, planting is generally used to supplement direct seeding. For example in some locations, tree species may be planted and the understorey layer direct seeded.

4.4.3. Site Preparation

4.4.3.1. Soil Preparation

In some areas, soil preparation will be required to produce loose, well drained and aerated soil ready for plant establishment. Various soil preparation techniques are described below.

Ripping

Ripping is recommended to assist root development by re-aerating clay-loams, clay soils, hardpans, or compacted soils. It aims to shatter dry subsoils, allowing easy and rapid root growth laterally and to depth, and to improve infiltration. Doing so will increase plant survival, vigour and stability. The alleviation of soil impedance can be critical for deep root development. Generally, ripping should be carried out to a depth between 300-400mm, and aim to minimise subsoil mixing with topsoil.

Ripping is best carried out when soils are dry to maximise effectiveness. Ripping should occur before the break of season, ideally with seeding following immediately afterwards, allowing sufficient time for some moisture to infiltrate the rip lines.

Mound Ploughing

Mound ploughing can also be utilised and involves surface cultivation that concentrates or builds up the surface of the land. Mound ploughing is generally used to raise the seed bed to reduce the effects of waterlogging. This technique of soil preparation is commonly used for heavy soils, waterlogged or saline soils. This technique tends to facilitate faster seedling establishment and growth and therefore reduce ongoing maintenance, particularly weed control.

Water harvesting

In low rainfall areas, water can be harvested to enhance plant establishment. Grading the surface of the soil at an angle along the contour and pushing it into a low embankment enables water to pool behind the bank. Seedlings can be planted into the rip lines on the slope, at the edge of the pooled water.

Furrow lining

Furrow lining is a technique which can be used in non-wetting sands. The process involves deep ripping and then creating a furrow which can be 300mm deep and up to one metre across. With the non-wetting sands removed from the soil surface, the rainfall can penetrate into the wettable soil below, where the seedling has been planted. To reduce erosion, create the furrow line across the direction of any potential damaging winds.

4.4.3.2. Soil Amendments

Most revegetation will use soil amendments. Soil amendments may be incorporated during site preparation. There can be considerable costs associated with soil amendments and the benefits should be justified. Amending soil can also alter native soils, potentially impeding the establishment of local native vegetation and encouraging the growth of weed species.

Fertiliser

Fertiliser can be applied to improve establishment of native plants, particularly in areas low in nutrients. However, fertilisers (in particular those that are nitrogen based) can promote weed growth and reduce native vegetation growth. Slow release fertiliser (i.e. low in phosphorus) is recommended. Some plant species, particular those of the Proteaceae family, can be harmed by phosphorus fertiliser (especially in sandy soils). Roots of seedlings can be damaged if fertiliser is placed too close to the plant.

The type of fertiliser and application rate will vary according to site, soil type and future landuse. Fertiliser requirements should be assessed on a project-by-project basis. The table below provides approximate usage information.

Revegetation Method	Previous Land Use	Suggested Fertiliser Usage
Topsoil regeneration only	Pastoral / native vegetation	Nil
Direct seeding	Native vegetation	100-200 kg/ha of slow release NPK with trace elements.
	Agriculture	Nil

Revegetation Method	Previous Land Use	Suggested Fertiliser Usage
Tree planting	Native vegetation	1 x 10-20g slow release NPK tablet per tree
	Agriculture	Nil

Mulch

Mulches can improve the micro-environment for seed germination and establishment, reduce evaporation and slows the movement of water across the soil surface. Examples of suitable materials include organic matter, wood chips, brush matting, and non-organic materials such as crushed brick, stone or gravel.

Although mulching can increase seedling survival through reduced evaporation, it can however inhibit germination, especially if the mulch application is too thick (e.g. >30mm). Generally, mulch will improve the establishment of plants from seed provided seeding is conducted prior to mulching and that mulch application is <30mm.

Gypsum

Gypsum can be used to improve the structure of sodic soils (i.e. soils with pH >8.5), reduce surface crusting or improve water filtration. It is normally incorporated into soil at approximately 5-10 tonnes/ha.

Lime

Lime can be used to increase the pH of acidic soils. Low pH (i.e. <5.5 when measured in water) can cause aluminium or manganese toxicity and reduce the availability of some nutrients. Some soils are naturally acidic, therefore, if local native plant species are used, amendment with lime should not be necessary. Application rates of lime are usually in the range of 2-5 tonnes/ha, but will vary according to soil type, pH, particle size and the source of the lime.

4.4.3.3. Erosion Control

Erosion can potentially damage a revegetation program and may require expensive remedial works.

Wind erosion can be controlled by:

- protecting the soil surface with mulching materials (mainly for smaller scale projects);
- maintaining the soil in an erosion resistant condition (e.g. moist, or with compacted surface crust); and
- reducing wind velocity across the site through establishment of wind breaks.

Water erosion can be controlled by:

- slowing the water flow across the soil surface (i.e. encouraging infiltration along the contour and building drainage structures);
- reducing the impact of rainfall on the soil surface (e.g. mulching); and
- maintaining the soil in an erosion resistant condition.

For more information regarding the types, impacts, legal requirements and recommended practices for controlling erosion, please refer to the [Water Corporation Guideline: Erosion and Sediment Control at Construction Sites](#).

4.4.3.4. Weed Control

Planning for weed management prior to, during and following revegetation works is very important to the success of the revegetation program.

Weed infestation at a revegetation site can be difficult to manage so emphasis should be on prevention rather than cure. Hygiene measures (e.g. appropriate cleaning of vehicles and machinery upon entry to project sites) must be followed so that the risk of introduction and

spread of weeds is minimised. Care must also be taken to restrict introduction of weeds through movement of soils (as a store of seed can be retained in the topsoil) and spreading mulches at the revegetation site. For more information on weed management, please refer to the Water Corporation Guideline: *Weed Management*.

4.4.3.5. Disease Control

Revegetation will typically involve movement of soil, and can lead to the spread of soil-borne diseases and pathogens. 'Phytophthora dieback' is particularly important and has long been recognised as a serious threat to both flora and fauna in Western Australia, especially in the south-west of the state. The disease is caused primarily by a soil-borne pathogen, *Phytophthora cinnamomi*. The unintentional movement of pathogen-infested soil by vehicles and machinery travelling from infested areas into healthy areas is by far the most common means of dispersal of the organism.

There are a number of ways to reduce spread of the disease that should be considered by Water Corporation personnel and contractors who work on or visit sites in the south-west that are susceptible to *Phytophthora dieback*. For example when machinery and vehicles cross dieback boundaries, mud and soil should be removed from the vehicles, machinery, as well as footwear, tools and equipment. For further information in relation to *Phytophthora dieback* and its management, please refer to the Water Corporation Guideline: *Dieback Management*.

4.5. Monitoring and Maintenance

It is essential to monitor the success of a revegetation program, and be prepared to rework areas where revegetation has not been successful. Sufficient funding must be included within the project budget to account for monitoring, remedial works and ongoing maintenance activities.

4.5.1. Completion criteria

Revegetation projects should include completion criteria that adequately address the objectives of the project. These criteria should be defined and agreed to by relevant stakeholders and in accordance with any regulatory conditions set (e.g. set as part of the clearing approval or for larger projects subject to statutory assessment) prior to commencement of revegetation activities.

Development of completion criteria should be based on specific indicators linked to the objective of the project and must take into account factors such as the location of the project, vegetation type, soil type and climate etc.. As vegetation establishment occurs over a number of years, any targets set need to reflect the establishment stage of the revegetation program (e.g. plant density targets will vary from year to year).

The following are examples of completion criteria that may be set:

- Plants are healthy (possibly assessed against a scale);
- Foliage cover is greater than 75%;
- Plant density is at least 2 plants/m² (this will vary according to species used, site conditions, climate etc.)
- Species diversity is at least 75% of the species originally seeded/planted or 60-80% of surrounding local native vegetation community.
- Planted seedlings (tubestock) have a survival greater than 80%; and
- Weed foliage cover is less than 10% and/or not inhibiting plant survival and growth.

Generally, a revegetation program may be considered successful when the site is managed for its designated landuse without any greater management inputs compared with adjacent areas with similar land use. Although the revegetated area may initially be different in structure compared with the surrounding native ecosystem, there should be confidence that over time, the area will change towards the make-up of the surrounding area. The revegetated area should be capable of withstanding normal natural disturbances.

4.5.2. Monitoring

Monitoring techniques must be designed to provide statistically valid results with a desired order of accuracy. The following are some of the key attributes that should be considered:

Sample size	The size and number of sample plots, must be adequate. The sample plot size should be appropriate to size and distribution of the units being measured.
Stratified sampling	It is critical to recognise distinctly different variables at the site and to design the monitoring program accordingly. For example, there may be differences in topography (slopes vs. flat areas), soil types, and revegetation treatments (e.g. seed mixes), each of which potentially produces different outcomes. Sampling should consider each of these individual areas with sample sizes in proportion to the size of the overall area. If this is correctly done, it will help identify the areas in which there are problems and distinguish them from other areas that are progressing satisfactorily.
Random sampling	All plots should be placed at random. This will remove any bias the sampler may have in selecting the location of sample plots

Monitoring (and maintenance) should be carried out over a number years (at least 3 years), and should be assessed against completion criteria set for the revegetation program. The table below details possible timings for monitoring activities.

Assessment	Timing	Components
Preliminary	Prior to revegetation works	<ul style="list-style-type: none"> • Weed assessment and maintenance
9 Month	Autumn (Feb-Apr)	<ul style="list-style-type: none"> • Success of seeding/planting • Weed monitoring and maintenance • <i>Recommendations for remedial works (including revegetation) and weed control</i>
15 months	Spring (Oct-Nov)	<ul style="list-style-type: none"> • Success criteria monitoring • Weed monitoring • <i>Recommendations for management</i>
	Autumn	<ul style="list-style-type: none"> • Weed monitoring and maintenance
27 months	Spring (Oct-Nov)	<ul style="list-style-type: none"> • Completion criteria monitoring • Weed monitoring • <i>Recommendations for management</i>
	Autumn	<ul style="list-style-type: none"> • Weed monitoring and maintenance
3 years	Spring (Oct-Nov)	<ul style="list-style-type: none"> • Completion criteria monitoring • Weed monitoring • <i>Recommendations for management</i>
*5 years	Spring (Oct-Nov)	<ul style="list-style-type: none"> • Completion criteria monitoring • Weed monitoring • <i>Recommendations for management</i>

* Monitoring and maintenance programs will typically apply for 3 years following the completion of the revegetation works. However, monitoring should be extended beyond this period if the allocated budget permits and/or if condition (e.g. ministerial or permit) require it.

4.5.3. Maintenance

Revegetated areas need to be monitored and managed following revegetation works. The success of revegetation may be reduced by a number of factors, including poor rainfall, poor planting technique, weeds and animals and other disturbances including human activities.

Maintenance activities will likely include:

- replanting failed or unsatisfactory areas (remedial works);

- weed and pest control;
- control of feral and native animal populations, including fencing;
- repairing any erosion problems;
- fertiliser application and other soil amendments; and
- watering of plants in drier areas, especially in the establishment phase.

Maintenance activities should typically be included as part of the revegetation works contract and/or monitoring and maintenance contract. Depending on the duration of these contracts (a minimum vegetation establishment period of at least three summers, following the completion of the revegetation works, is recommended for most projects), further maintenance may be required once contracts expire. Maintenance activities required are likely to be limited to weed control and possibly fencing. If remedial works are required, supplementary contracts may be needed. However, provisions for remedial works should be included in the original budget. It is common for a provision sum of 30% to be included as part of a quote.

4.5.4. Responsibilities

Generally, the Project Manager will be responsible for coordinating the revegetation works and for monitoring and maintenance activities for at least the first year following the completion of the revegetation works. Following this period, responsibility will typically be handed over to Regional Manager and/or the Asset Manager. It is important that the terms of this hand-over are finalised prior to commencement of revegetation works. This may include the contract documents, warranties, any outstanding tasks to be completed, and a handover budget, which should include sufficient funding to carry out a monitoring and any maintenance and remedial works. Advice on revegetation works, monitoring and maintenance activities can be sought from the Environment Branch.

5. Records and Reporting

Any records produced in association with a revegetation (e.g. revegetation plan, monitoring reports etc.) must be maintained in AQUA.

Specific details of the site to be revegetated (including area (ha), location (GPS coordinates) and revegetation program progress (e.g. monitoring status)) must be entered into the *Vegetation Management* corporate database for record and auditing purposes. This database will be linked to AQUA.

Where revegetation works are a requirement of regulatory conditions (e.g. as part of a clearing permit or for larger projects subject to statutory assessment), the imposed conditions must be entered into Water Corporation's Regulatory Conditions Management System (RCMS). RCMS is used to monitor conditions of the approval, and the actions undertaken to substantiate compliance with each condition. For further information regarding the use of RCMS, refer to Water Corporation Guideline: *Using the Regulatory Conditions Management System (RCMS)*.

6. Related Documentation

Water Corporation Policy: Biodiversity Policy

Water Corporation Guideline: Dieback Management

Water Corporation Guideline: Erosion and Sediment Control at Construction Sites

Water Corporation Guideline: Using the Regulatory Conditions Management System (RCMS)

Water Corporation Guideline: Weed Management

Water Corporation Scope: Scope of Works Template - Revegetation Works

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ANNEXURE 3

Drafting and Implementing Environmental Management Plans

1. Purpose

The Water Corporation is required to prepare Environmental Management Plans (EMPs) to meet its obligations for statutory environmental approvals. This guideline outlines the Water Corporation's expectations with regards to the drafting and implementation of EMPs.

Water Corporation Accountabilities Framework Process: Manage Environmental Compliance.

2. Scope

This Guideline applies to:

1. All Water Corporation staff preparing EMPs for the Water Corporation.
2. External consultants preparing EMPs for the Water Corporation.

3. References

The following references apply to this Guideline:

1. Policy: PCY254 Regulatory Compliance.
2. Policy: PCY289 Environmental Management and Coordination.
3. Standard: Environmental Approvals and Compliance Standard.
4. Guideline: Drafting Environmental Management Conditions.

4. Definitions

1. Condition – a legally binding requirement imposed by a regulator. Conditions also include Proponent Commitments made under Part IV of the *Environmental Protection Act 1986*.
2. EMP – a document that describes the actions to be undertaken by the Water Corporation regarding a specified number of environmental matters.
3. Statutory Approval – an authorisation under a written law to conduct a specified activity.
4. CEMS – The Water Corporation's Corporate Environmental Management System.

5. Action or Activity

The Water Corporation obtains statutory approvals under environmental legislation to develop and operate water, wastewater and drainage infrastructure. Examples of statutory environmental approvals include Licences, Permits, Works Approvals and Statements issued by the Department of Environment.

Statutory approvals contain conditions to which the Water Corporation must comply. The conditions imposed often require the preparation of an EMP(s) for the management and/or monitoring of specified environmental matter(s). In most cases such EMPs are written and/or implemented by consultants on behalf of the Water Corporation.

Failure to comply with a condition (ie preparation and/or implementation of an EMP) is a criminal offence for which penalties apply. It is important that staff and consultants drafting and/or implementing EMPs understand the potential legal consequences related to the drafting and implementation of EMPs.

The following **Principles** apply to drafting EMPs:

1. An EMP must state the relevant statutory approval and condition(s) to which it applies. An EMP must address all requirements of the relevant condition(s), and should be limited to that scope.
2. An EMP should specify the actions to be undertaken (when, what, where, why, who and how) such that no further consideration is required for its implementation. EMPs should be concise and free of unnecessary detail.
3. An EMP should consider application of the following matters:
 - Element/issue.
 - Performance criteria and/or statutory requirement.
 - Actions to be undertaken.
 - Implementation strategy.
 - Monitoring/measurement of performance.
 - Timing of actions.
 - Contingency actions.
 - Decommissioning.
 - Stakeholder consultation.
 - Reporting & review.

Not all of the above matters will be relevant for all EMPs.

4. All EMPs shall contain the following text within the body of the EMP under the heading of *Specifications*:

The materials and methodology stated in this plan are correct as at the publication date. The materials and/or methodology may change during implementation of the project provided that those changes do not result in an additional or significant environmental impact. Changes to the materials or methodology that may cause an additional environmental impact will be referred to the relevant advisory agencies.

5. All EMPs shall contain the following text within the body of the EMP under the heading of *Changes to this Plan*:

The requirements of this plan may be reviewed from time to time. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the relevant advisory agencies.

If the legal requirement is different to seeking the 'advice' of the relevant advisory/regulatory agencies, that different requirement should be inserted.

6. The EMP must not create requirements for additional EMPs to be prepared.

The following **Principles** apply to implementing EMPs:

1. An EMP must be implemented only as described in the EMP.
2. If there is a need to amend the manner of implementation, amendments must be approved by Manager Environment prior to a change to implementation. Manager Environment will assess whether such amendments require consideration/approval from the Department of Environment and/or specified advisory agencies.
3. Implementation of an EMP should be recorded where specified actions are required. For example, where inspections are required at a specified frequency, such inspections should be documented by way of an inspection log or checklist.
4. Reporting on the implementation of an EMP (if required) should be clear and concise. As a minimum, reports should contain:
 - a. A summary (1-2 pages) that includes

- i. Identification of the relevant statutory approval and condition(s).
 - ii. a description of the infrastructure and its location (a map or aerial photograph may also be beneficial)
 - iii. a summary of results (including any variances to agreed standards or targets) related to any recorded environmental impacts or absence thereof.
- b. Results (not raw data) and a description of the results for each measured parameter. Where the results are at variance to an agreed standard or target, an explanation of why the variance occurred should be provided (where known).
 - c. Appendix containing raw data, laboratory analysis reports, chain of custody forms, specialist consultant reports, etc (as appropriate).

6. Responsibilities/Accountabilities

EMPs prepared by external consultants are to be submitted to the Water Corporation for review. The Water Corporation, as the client, has the final authority on any inclusions, exclusions or amendments to an EMP for Water Corporation's infrastructure.

Manager Environment is responsible for submission of EMPs to the relevant regulators and/or advisory agencies on behalf of the Water Corporation. Manager Environment is responsible for ensuring that a copy of each EMP is added to the CEMS and the Corporate Document Management System.

7. Documentation

Nil

8. Appendix

Appendix 1 Document Administration

Hardcopy Distribution Record (locations of hard copies of this document)

Position	Location	Copy Number

Target Audience (Positions with specific responsibilities under this document)

Position	Position
Environmental Staff	External Consultants
Project Managers	

Document Amendment History (amendments to this document)


Version	Initiator	Reason	Section	Summary	Reference
17/01/07	Hawkins, S A	First Issue			

D. Luketina
 Manager, Environment
 17 January 2007

APPROVED BY:	MANAGER ENVIRONMENT, BUSINESS SERVICES DIVISION
REVIEW DATE:	January 2009

ANNEXURE 4

Weed Management Guideline

 <p>WATER CORPORATION ABN 28 003 434 917</p>	<h2 style="margin: 0;">Weed Management Guideline</h2>
<p>Doc ID 592093-v2</p>	<p>Custodian <i>Manager, Environmental Operations</i></p>
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1. Purpose

The Water Corporation aims to protect and enhance biodiversity on land under its influence and is committed to avoiding or minimising adverse impacts on biodiversity. Biodiversity can be affected by the Corporation's activities, particularly through our management of land and asset development. The disturbance of biodiverse areas resulting from these activities can lead to the introduction and spread of weeds, which can lead to significant impacts on biodiversity.

This document provides guidance on the preparation and implementation of weed management measures. It is designed to guide land managers on aspects involved and is intended to support, but not replace, specialist advice on weed management activities.

2. Scope

This guideline addresses the following areas:

- o Definition of weeds and their impacts;
- o Key weed control methods; and
- o Monitoring and maintenance requirements.

Weed management may be required for standard on-going maintenance works (e.g. non-formal infrastructure maintenance), or for larger project related weed management activities (e.g. as part of revegetation works or under ministerial commitment).

3. Definitions

Annual Plant	A plant (weed) that usually germinates, grows, flowers, produces seed and dies within a single year (Tootill, 1984).
Environmental Weed	An introduced plant that establishes in natural ecosystems and adversely modifies natural processes, resulting in the decline of invaded communities (EPA, 2007).
Herbicide	Chemicals used to control weeds (Water and Rivers Commission, 2000)
Pesticide	A substance or compound used or intended to control, destroy or prevent the growth and development of, any fungus, virus, insect, mite, mollusc, nematode, plant or animal (Water and Rivers Commission, 2000).
Perennial Plant	A plant (weed) that lives for many years (Tootill, 1984).
Public Drinking Water Source Area	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> and the <i>Country Areas Water Supply Act 1947</i> (Water and Rivers Commission, 2000).
Weed	A plant that requires some form of action to reduce its harmful effects on the economy, the environment, human health and amenity, and can include plants from other countries or other regions in Australia of WA (EPA, 2007).
Annual Plant	A plant (weed) that usually germinates, grows, flowers, produces seed and dies within a single year (Tootill, 1984).

4. Weed Management Guideline

4.1. Introduction

4.1.1. What are weeds

Weeds are plants that are not considered native to Western Australia, and have the capacity to impact upon environmental, social and economic values (EPA, 2007). The Environmental Weed Strategy for Western Australia describes management priorities and general control measures, and monitoring of environmental weeds (also refer to [Section 4.1.3.3](#)). Weeds may include trees, shrubs, herbaceous plants, grasses, vines and aquatic plants. Western Australia has over 1200 recognised weed species.

For guidance identifying (and managing) common weeds, the tools and references listed below may be useful.

- o Department of Agriculture and Food (DoAF) (<http://www.agric.wa.gov.au/weeds.htm>) – the current list of declared plants, including descriptions and control methods. The DoAF can also be contacted for assistance with weed identification and for reporting serious weed matters.
- o [FloraBase](#) – a database that contains library catalogue of flora species collected and recorded formally across WA. FloraBase includes a search engine, which allows for a number of different search types (e.g. by family, genus, species, etc.) and also contains list of Western Australian weeds (listed alphabetically by family or genus); most with descriptions, supporting photos and recorded locations. The database currently has record of 1,320 alien taxa (weeds) that have been recorded within the state.
- o Weeds Australia website (www.weeds.org.au) - provides a useful weed identification tool (including a break down by regions) and other weed information.
- o Weeds CRC website (www.weedscrc.org.au) - provides a number of factsheets, guidelines and weed management guides relating to significant weeds of Australia (please note this site is no longer being updated).
- o [Western Weeds](#) (book) - describes about 1050 weeds, which includes 625 colour photos and 15 line drawings. Descriptions range from brief to detailed with sufficient information being given, along with the photograph, to enable identification. Diagrams to explain plant structures and to aid in identification are provided in the text (copy located at the Water Corporation Library and Environment Branch).
- o [Southern Weeds and their control](#) (booklet) – provides an easy identification of common weeds and methods of control using common cultural, biological and herbicidal control techniques (copy located at Environment Branch).

(For further guidance, including obtaining specific reference materials, please contact the Environment Branch).

4.1.2. Impacts of weeds

Weeds pose a significant threat to biodiversity and conservation values of Western Australia, as well as primary production, the economy, human health and amenity. Weeds also increase the risk of fire, increase costs to infrastructure maintenance and reduce the amenity of recreation areas. Weeds can also impact upon wetland ecology, potentially threatening irrigation channels and blocking waterways.

Generally, weeds grow faster and out-compete native plants for available nutrients, water, space and light. Native plants can be smothered by weeds that can then dominate ecosystems. As a result, native vertebrate and invertebrate fauna habitats and food sources may also be affected. Weeds can produce large numbers of seeds, increasing their ability to survive and dominate ecosystems. Weeds can rapidly invade land that has been disturbed through clearing and changed fire regimes. Early identification and management of weeds, however, will reduce their impact and make it easier and more economical to eradicate.

4.1.3. Relevant Legislation and Strategies

4.1.3.1. Declared Weeds

Weeds that pose a significant problem to agriculture or the environment may be 'declared' under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). If a plant is declared under the Bam Act, the Water Corporation is obliged to control that plant on its properties. Declarations specify a category, or categories, for each plant according to the control strategies or objectives that are appropriate in a particular place. A current list of declared plants, including descriptions and control methods, can be found on the Department of Agriculture and Food's web site (www.agric.wa.gov.au).

4.1.3.2. The Australian Weeds Strategy

At the Commonwealth level, the *Australian Weeds Strategy: A National Strategy for Weed Management in Australia, 2007* provides a national framework for weed control, identifying priorities for weed management and specifically focusing on 'Weeds of National Significance' (WONS). A list of WONS is located on the [Weeds of National Significance website](#).

4.1.3.3. Weed Plan for Western Australia

A Weed Plan for Western Australia (referred to as the 'State Weed Plan'), released in 2001 by the then Department of Agriculture (now Department of Agriculture and Food), aims to achieve coordinated, collaborative and effective weed management throughout Western Australia. Implementation of the State Weed Plan coincides with implementation of the *Environmental Weed Strategy for Western Australia* developed in 1999.

4.2. Weed Prevention and Control Methods

4.2.1. Preventative Measures

Prevention, early detection and rapid intervention are the best strategies, and in many cases the only effective strategies, that can be used to avoid long-term weed management costs and impacts. Water Corporation properties should be regularly assessed for weeds and potential weeds. Preventing new invasions of weeds is cost effective and more successful than eradicating weeds once established. The invasion of weeds can be prevented by:

- minimising disturbance of soil and avoiding importation of foreign soil;
- following general hygiene measures (refer to [Section 4.5](#));
- excluding stock and stock feed from bushland;
- avoiding fertiliser use in or near bushland;
- planting only local native species and avoiding potential environmental weeds; and
- educating and communicating with Operation, Asset and Project Managers about the threat and problem of weeds.

4.2.2. Chemical Control (Herbicides)

Chemical control is generally the most common method of weed control. Herbicides are an attractive option because of their effectiveness and practicality in a wide variety of weed control situations. Herbicides alone or integrated with other control methods can prove to be the most economical means of control, requiring less labour, fuel and equipment than other methods.

Chemical control methods involve the spraying of plants with a herbicide solution to kill or slow the growth of the vegetation. Key herbicide types are summarised below.

Contact	Kills only plant tissue to which it has been applied. Old or well-established annual plants may grow back after such treatments.
Systemic herbicide	Penetrates plant cells and moves through the plant from shoots to roots.
Broad spectrum	Kills a wide range of plants.
Selective	Kills only a particular type of plant, e.g. grasses.
Non-residual (knockdown)	Kills existing plants but has no effect on subsequent germinant.
Residual	Remains active in soil for some time (may kill germinating seeds, pre-

	emergent and susceptible plants).
Pre-emergent	Applied to the soil before the weed emerges, killing emerging seedlings (pre-emergent herbicides will also kill susceptible native seedlings).
Post-emergent	Applied directly to established plants and/or soil.

Generally, herbicide selection should take place once the key weed species have been identified. Most grass species can be specifically targeted through blanket applications of *Fusilade*, which is recommended where possible as it is a grass specific herbicide and will keep off target damage to a minimum. There are also herbicides that are more effective at controlling specific species, such as *Metsulfuron-methyl* which is very effective against species that have bulbs, corms, or tubers (e.g. Bridal Creeper).

Where weed management is required as part of a revegetation program, a combination of knockdown and residual herbicides may give the best results. However, the time of herbicide application is critical (refer to [Section 4.2.6](#)).

Selection and application of herbicides requires experienced knowledge and advice. Rates of application, safety directions and precautions on the Material Safety Data Sheets (MSDS) supplied with all herbicides should be strictly adhered to.

For information relating to decision making on the use of herbicides (and pesticides) and reducing the risks to the environment when using herbicides, refer to the Water Corporation Guideline: [Use of Pesticides \(Herbicides and Insecticides\)](#).

4.2.3. Physical Control

Physical weed control includes the use of manual or mechanical methods to pull out, cut or otherwise damage or remove plant tissue or wood. Some common physical control methods are detailed below.

Cultivating

Annual weeds can be controlled through repeated cultivation of weed-affected soils. This method is less effective for perennial weeds. Implements range from large tractors and ploughs down to hand tools and chipping hoes. However, a lead time of at least one year is required prior to revegetation. Cultivation alone, however, is generally not recommended and needs to be used in conjunction with herbicides. For effective control by cultivation, weeds should be controlled before flowering and under reasonably dry conditions.

Slashing

Slashing involves mowing down or brushcutting aboveground biomass. It can be used to prevent tall growing weeds from flowering and setting seed, however, may not be useful on its own. Slashing is not effective in eradicating a weed, but can help with temporary control of a plant until it re-shoots. Slashing is generally cheaper than cultivation and preserves the ground cover, thus reducing soil erosion and improving access in wet weather.

Scalping

Scalping is a technique where the top layer of soil is graded or scraped away, effectively removing the weed seedbank, roots, rhizomes, bulbs etc.. However, many native seeds may also be removed. This is a method that needs to be used with caution and usually only suitable for heavily degraded and weed infested sites with little native material remaining. This method also creates very high disturbance and is best suited to sites that will undergo complete rehabilitation.

Mulching

Mulching involves the use of physical barriers to exclude sunlight and so prevent weed establishment. Natural mulches include sawdust, timber chips, straw, manures and grass clippings. Natural mulches have other beneficial effects by adding organic matter and nutrients to the soil. Artificial barriers such as black plastic sheeting, woven paper products or woven cloth can also be used. Mulches are however, awkward and time-consuming to apply and, in

some cases, may introduce weed seeds. Most perennial weeds will also penetrate mulches such as sawdust and wood chips.

Nutrient Manipulation

High nutrient levels often give weeds an advantage over native vegetation. By removing a nutrient source (often associated with water), the balance can be tipped back in favour of the native vegetation.

Hand Pulling

Hand pulling aims to remove the entire weed including its roots from the soil. This method is useful for small scale infestations, or with a team of workers. It is not appropriate for all weed species, such as those with underground bulbs. It is best to hand pull weeds after rain when soil is moist. Hand tools such as broad knives and trowels can be used to remove underground parts of weeds (such as bulbs) that may re-shoot. In some cases it is necessary to dig out the crown of the weed. This requires the growing part of the plant to be cut beneath the ground using a knife. It is easiest to remove the crown from moist soil.

Smothering (out-competing weeds)

Planting native colonising species, at medium to high plant densities will allow the natives to out-compete some weed species. Once the native vegetation is taller than the weeds it reduces light and space available for the lower growing weeds, which reduces their vigour and population.

Topping/Felling

Woody weeds and tree weeds can be pushed with bulldozers or felled by chainsaw and snigged (dragged away). These methods are only suitable in certain contexts, as they create high levels of soil and vegetation disturbance.

4.2.4. Biological Control

Biological control involves the use of a plant's natural enemies such as insects, mites and diseases to control its population. It is an economical, effective and environmentally sound method of weed control. However, this method is a long-term technique and requires extensive development and establishment phases. Biological controls may not eradicate a weed completely, but if successful, can reduce it to an acceptable level where it can be controlled by other means. There are two main types of weed biological control: inundative (use of mycoherbicides) and classical (the release of control agents such as insects etc.).

4.2.5. Weeds in Waterways and Wetlands

Prevention is the best control measure. However, if this is not possible, early removal of any new arrivals, before a major infestation can form, is the next best measure. Removal of weed infestations on wetlands should start from the edge of the infestation, working around towards the centre. On waterways, work should begin from the upstream end moving downstream, taking care to minimise the spread of cuttings which could take root downstream.

For further information on waterway and wetland weed management, refer to the Department of Water Website (www.water.wa.gov.au).

(Use of pesticides in or near waterways and wetlands is generally restricted and extra care must be taken (refer to [Section 4.3](#)).

4.2.6. Timing

Weed management controls should be designed to exploit the characteristics of the weed species concerned. For example, prior to setting control requirements for particular species, information should be established on the:

- life cycle (annual or perennial);
- dormant and active growing periods;
- time of flowering and seed set;
- timing of seed germination;
- degree of hardseededness (i.e. impermeability of seed coat); and
- most cost-effective time to apply control.

For herbicide use, application should be after most weed seed has germinated, but before the early germinants can flower and seed again. Chemical control is most effective at the seedling stage of growth for most weed species. For annual weeds, control is only effective if seed set is prevented. For perennial grass weeds, grass-selective herbicides are only effective if applied just before flowering. For weeds that die down to bulbs each year, chemical control must be systematic and take place just before flowering when the bulb is exhausted. For some woody weeds, seasonal conditions will affect the uptake of stem-injected herbicides.

As weed seeds can persist in the soil over a number of years (due to hardseededness), with only a portion of the seed bank germinating in any year, weed management programs may need to extend over a number of seasons. In the case of a revegetation program, depending on the extent of weed cover, weed control measures may need to commence at least two seasons prior to revegetation works. More than one pre-sowing or planting application may be necessary. The lead time required prior to revegetation works may vary. The type of weeds present and densities should be determined during the preliminary assessment of the project area. This will assist in developing a weed management plan.

4.3. Herbicide Usage in Water Catchment or Source Areas, Wetlands and Rivers

If herbicides are applied in or near Water Catchment and Source Areas, Wetlands or Rivers, there are a number of government policy and guidance documents that need to be followed.

The Department of Health's (DoH) publication Management of Pesticide in WA - An Information Resource provides a short summary of pesticide use, the legislation and responsibilities of the government departments that govern the use of herbicides (pesticides) in WA.

The DoH's Policy Circular No. PSC 88 must be adhered to when using herbicides in 'water catchment areas'. This circular defines 'water catchment areas' as public drinking water source areas that are proclaimed under the *Country Areas Water Supply Act 1947* or the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, and provides details in relation to approved herbicides and herbicide application and storage instructions.

The Department of Water's (DoW) (formerly Water and Rivers Commission) Statewide Policy No.2 Pesticide Use in Public Drinking Water Source Areas (2000) applies to herbicide (pesticide) usage in Public Drinking Water Source Areas (PDWSAs). The policy applies to the transportation, approval for use, application, storage, mixing, disposal and monitoring of pesticides within PDWSAs in Western Australia. Herbicide use in PDWSAs requires approval of the DoW (except the herbicides listed in PSC88) and is governed by by-laws under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.

There are several key points to consider prior to applying a herbicide in a PDWSA:

- Herbicide should only be used when no other means are suitable for the control of weeds;
- Blanket area spraying is not acceptable in a PDWSA (for definition refer to Circular No. PSC 88);
- No herbicides should be applied in a reservoir protection zone (2 km radius around reservoir) and wellhead protection zone (P1 - 500 m radius, P2 and P3 - 300 m radius) without the Department of Water's approval (refer to Statewide Policy No.2 Pesticide Use in Public Drinking Water Source Areas (2000));
- Herbicides used to control weeds in a PDWSA should be approved by the DoW (if not listed in PSC88) and be applied according to the relevant guidelines and best management practices, including the most appropriate methods at the time;
- Care should be taken to avoid herbicides being washed or transported into reservoirs, water courses, or wetlands (applications should be in dry conditions); and

- Records of the type, amount and dates of use of the herbicide in the PDWSA are to be retained.

There are a number of information sheets available that are related to herbicide usage near water including the DoW's Water Notes No. 22 – Herbicide use in wetlands and Weed CRC's Herbicides: guidelines for use in and around water. These sheets provide information related to issues associated with herbicide use in wetlands (e.g. frog friendly herbicides) and recommendations regarding its use.

4.4. Disposal of weeds

It is important to thoroughly dispose of weeds once they have been removed to ensure the waste material doesn't become a further weed problem. The seed heads of many plants remain intact while they are attached to a living plant but once a seed head is cut off or pulled out the plant material will quickly dry out and release seeds. All plant material should be removed from the site the same day and disposed of correctly to landfill.

4.5. General Weed Hygiene Measures

When undertaking any clearing, revegetation and rehabilitation or weed control, it is important that hygiene measures are followed. The risk of introduction and spread of weeds must be minimised, and should include (but not be limited to) the following steps:

- clean soil and vegetation from earth-moving machinery and other vehicles prior to entering and leaving the area to be cleared;
- ensure that no weed-affected construction materials, mulch, fill or other material is brought into the area; and
- restrict the movement of machinery and other vehicles to the project area.

4.6. Engagement of Contractors and Consultants

For standard maintenance works (e.g. ongoing infrastructure weed spraying), local herbicide (pest control) contractors should be engaged to carry out the required works in accordance with a scope of works.

For larger project related weed management (e.g. revegetation works or works required under ministerial commitment), pre-qualified environmental consulting service providers can be engaged via the Environmental Consultants Panel (refer Panel for the Provision of Environmental Consulting Services located on the Procurement Branch's website).

It is important to note that all persons engaged in spraying herbicides require a current pesticide (herbicide) operator's licence issued by the DoH (Pesticide Safety Branch). Also, as with Water Corporation staff, contractors are required to comply with the Water Corporation's Environmental Management System.

4.7. Weed Management Plan

For standard ongoing maintenance works, it may not be necessary to develop formal detailed weed management plan. However, weed management measures should follow a scope of works or be integrated as part of *Local Environmental Improvement Plans* developed prior to control measures being administered. The scope of works should not only include management control requirements, but also monitoring requirements to determine whether controls are successful and whether additional maintenance is required.

For larger projects (e.g. revegetation works or management required under formal commitments), it is important that weed control is integrated with an overall plan of management. A specialised contractor should be engaged to coordinate and/or carryout a weed management program. A scope of works should be developed and include the

appropriate aspects of the weed management program. There are a number of key considerations for developing a weed management plan. These are provided below:

1. Assessment of weed infestation:
 - a) Determine weed species
 - b) Scope and size of the infestation
 - c) Map weed infestations
2. Plan the implementation of the control measures:
 - a) Control measures suitable for the infestation(s) to be selected
 - b) Develop success criteria (e.g. <5% weed cover)
 - c) Implementation Plan (inc. schedules in relation to different species and time-frames)
 - d) Suitable safety equipment and personal protective equipment advised
3. Monitoring and maintenance:
 - a) Devise monitoring Plan (inc. schedule and time-frames)
 - b) Monitor weed control measures as per designated schedule
 - c) Assess for maintenance requirements (e.g. supplementary weed control)
 - d) Schedule follow-up control program if required.
4. Recording and Reporting:
 - a) Records of weed control and monitoring activities should be maintained
 - b) Performance reports should be produced annually or following supplementary assessments.

4.8. Monitoring and Evaluation

Monitoring is integral to the success of a weed management program and along with maintenance provisions, should be considered in the design and funding of a project. Monitoring can be crucial for successful weed management and can result in early weed detection. All weed control treatments should be monitored accurately and records kept for future review and audit purposes.

It will be critical to monitor the project site during the initial stages of weed control for reinvasion of weeds and control them as they appear. Generally, monitoring should be conducted within eight weeks of the initial control program (preferably after rainfall) and should include an evaluation of the success (performance) or the control measures. Follow-up monitoring should be scheduled at least annually and should coincide with revegetation monitoring if the weed management forms part of a revegetation program. It should be noted, a detailed monitoring program may be more appropriate for larger weed management programs. For standard maintenance works, monitoring and maintenance requirements set out in the scope of works may be sufficient. In this latter case, annual contractor performance reviews may be necessary. This should be coordinated by the Region, Asset Owner/Manager, Project Manager or Operations Manager.

Depending on the finding of these monitoring activities, follow-up weed control may be necessary. It is important that sufficient provisions for both monitoring and maintenance activities are included within project cost estimates and budgets.

For more formal weed management programs (e.g. revegetation works or weed management under ministerial conditions), records of the assessment should be maintained and should include qualitative observations and quantitative measurements where relevant. These observations/measurements may include, but are not necessarily limited to, the following:

- o effectiveness of control measures;
- o size, scale and distribution (e.g. estimate of number, cover or density) of the infestation area;
- o comparison with size and distribution prior to treatment;
- o other observations of relevance to the control of weed species; and
- o schedule for further treatments and/or inspections if required.

5. Related Documentation

Water Corporation Guideline: *Use of Pesticides (Herbicides and Insecticides)*

6. References

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ANNEXURE 5

Dieback Management Guideline

Doc ID xxxxx-v1	Custodian Steve Wilke (14237)
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Purpose

The Water Corporation is required to manage and minimise the risk of introduction and spread of the plant pathogen, *Phytophthora cinnamomi*. This guideline describes the pathogen and how to minimise the risk of introduction into unaffected areas and to avoid spreading the pathogen in areas where it is or may be present.

Currently the Department of Environment and Conservation is developing new protocols and signage for the management of *Phytophthora* dieback. This Guideline will be reviewed as these become available.

Scope

This Guideline applies to all staff and contractors involved with the construction and/or maintenance of the Water Corporation's assets, particularly in the south-west of Western Australia.

Definitions

- **Accreditation** means a person officially recognised by an authorised body as being able to undertake specified tasks to a guaranteed standard. For example, the detection, diagnosis, mapping and field demarcation of disease caused by *Phytophthora cinnamomi* in native vegetation, or the training and/or certification of interpreters.
- **Adaptive management** means a process of responding positively to change. The term adaptive management is used to describe an approach to managing complex natural systems that builds on common sense and learning from experience, experimenting, monitoring, and adjusting practices based on what was learned.
- **Autonomous** means independent. For example, *Phytophthora cinnamomi* can move independently through suitable habitat by way of zoospores (swimming or washed) and mycelium growth.
- **Disease** means a combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.
- **Host** means a plant that supports the growth and development of the parasite that has infected it.
- **Interpreter** means a person who undertakes the tasks associated with the detection, diagnosis, mapping and field demarcation of disease caused by *Phytophthora cinnamomi* in native vegetation.
- **Pathogen** means any organism (e.g. *Phytophthora cinnamomi*) or factor that causes disease in a plant.
- **Phosphite** means an aqueous solution of mono-potassium phosphite and dipotassium phosphite.
- **Qualified** means a person who meets the training and experience conditions required before the right to act in a specified role. For example, a disease interpreter.

- **Sporulation** means the developmental process by which a fungal cell becomes a spore. It is sometimes taken to include release of spores into the environment.
- **Susceptible** means influenced or harmed by a parasite. For example, *Phytophthora cinnamomi*.
- **Threat** means an indication that serious or irreversible environmental damage may occur. For example, a process is defined as a threatening process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.
- **Uninfested** means an area that an accredited person has determined may be free of plant disease symptoms that indicate the presence of *Phytophthora cinnamomi*.
- **Vector** means a living agent that transmits a pathogen from an infected plant to an uninfected one. For example, feral and native animals, humans.
- **Vulnerable** means susceptible to physical injury.
- **Vulnerable zone** means that part of the South West Land Division and the areas adjoining it to the north west and the south east that receives mean annual rainfall greater than 400 mm in which susceptible native plants occur in conjunction with the environmental factors required for *Phytophthora cinnamomi* to establish and persist.

References

The following references apply to this guideline:

1. Best Practice Guidelines for the Management of *Phytophthora cinnamomi*; CALM (now DEC) 2004
2. Managing *Phytophthora Dieback* – Guidelines for Local Government; Dieback Working Group (DWG) 2000
3. Arresting *Phytophthora Dieback* – The Biological Bulldozer; WWF-Australia (WWF) & the Dieback Consultative Council (DCC) 2004
4. *Phytophthora Dieback Atlas* – From the bush to your back fence: What you need to know; DEC 2006
5. The ecological impact of *Phytophthora cinnamomi* in the Stirling Range National Park, Western Australia. *Australian Journal of Ecology*, 18: 145-159; R.T. Wills, 1993.

Guideline

What is *Phytophthora dieback* and where does it occur?

The disease previously known as "jarrah dieback" or "dieback disease" has long been recognised as a serious threat to the conservation of both flora and fauna in Western Australia, especially in the south-west of the state where the greatest diversity of plants is found. The Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* lists *Phytophthora dieback* as a 'key threatening process'. The disease is caused by a soil-borne pathogen (technically classified as a water mould, not a fungus), *Phytophthora cinnamomi*.

The unintentional movement of pathogen-infested mud by vehicles travelling from infested into healthy areas is by far the most common means of dispersal of the organism, although movement of the pathogen in mud carried along trails by both bushwalkers and animals can also have an impact. Spread is much faster downslope.

The scientific name "*Phytophthora*" (pronounced "fy-tof-thor-a") is derived from the Greek "phyton" meaning "plant" and "phthora" meaning "destruction". Many plant species are killed by this water mould, and important families of plants from Western Australia contain a large number of susceptible species.

Although it is not known how many species of plants might be susceptible, it is estimated as many as 2300 of the 5700 species in the south west may be susceptible to *Phytophthora dieback* (Wills 1993).

Phytophthora dieback disease generally affects woody shrubs. Grasses, sedges, rushes, and orchids have rarely been recorded as hosts and have usually been regarded as resistant to infection. The water mould invades the conducting elements of the plant and causes the failure of root conductance, and so plants which are killed die largely as a result of "drought".

The four most important woody plant families in Western Australia are the *Myrtaceae* (eucalypts, paperbarks, bottlebrushes etc.), the *Papilionaceae* (pea-flowered plants), the *Proteaceae* (e.g. *Banksia*, *Grevillea*, *Dryandra*, *Hakea* etc.), and the *Mimosaceae* (wattles).

Variation in annual rainfall has a significant influence on populations of *Phytophthora cinnamomi* due to its affect on soil moisture. Any rainfall pattern promoting moist soil conditions over summer will allow rapid growth of the water mould within the host and thus may cause significant disease expression. However, the most severe impact of the pathogen may well occur after the combination of autumn and summer rains. Autumn rains would contribute to the early recharge of soil moisture after summer and allow an increase in population size of the water mould before growth becomes limited by winter temperatures. As temperatures begin to rise in spring, populations of the water mould that had built up in autumn would continue to expand as long as moisture is available. Substantial rainfall in summer would then create ideal conditions for the growth and sporulation of *Phytophthora cinnamomi*.

Phytophthora cinnamomi has infested many of those habitats which provided a suitable food-base and year-round moist conditions for the water mould. However, areas with seasonally dry soils and dominated by species susceptible to the pathogen are also being invaded in years when above average rainfall produces high soil moisture conditions. Variability of summer rainfall is particularly important since, every few years, heavy summer rains occur, generating free soil water in the warmest months. These circumstances not only provide ideal conditions for the growth of this tropical organism but also favour the initiation and growth of fine roots which are an important avenue of invasion for the pathogen.

Phytophthora dieback now extends from Eneabba to Esperance. It has the greatest potential to occur in the south-west above the 600mm isohyet, although infestations have been recorded between the 400mm and the 600mm isohyets. The DEC has produced the *Phytophthora Dieback Atlas*. This has involved the mapping of more than 700,000 ha of land in the south-west and southern coastal areas. This extensive mapping has been carried out for strategic planning and is NOT suitable for designing hygiene management actions at particular sites.

How to stop the spread of *Phytophthora dieback*

Phytophthora dieback is most rapidly spread through human activity resulting in the movement of infested soil on vehicles, equipment & footwear. Therefore, this risk of spread of the disease can create a significant problem for construction projects. It is also an important issue for recreational bushland users such as four-wheel-drive vehicles, off-road motor bikes, mountain bikes and bush walkers.

To prevent the spread of Phytophthora dieback into an uninfested area or within an area, the Water Corporation and its contractors need to adopt strict hygiene measures. These hygiene measures don't need to be a hindrance, but they do require some forward planning. During the planning stage it is important to determine the risks associated with the operation. The table below outlines examples of activities that are high risk or low risk.

High Risk Sites	Low Risk Sites
<i>operation over large area</i>	<i>operation over small area</i>
<i>complex operation</i>	<i>simple operation</i>
<i>much machinery</i>	<i>few machines</i>
<i>much soil movement</i>	<i>little soil movement</i>
<i>untrained personnel</i>	<i>well trained / experienced personnel</i>
<i>wet conditions</i>	<i>dry conditions</i>
<i>sticky soils</i>	<i>non-sticking soils</i>
<i>low lying site</i>	<i>elevated site</i>
<i>dieback known nearby</i>	<i>dieback not known nearby</i>

Prior to the commencement of activities on a site in the south-west of Western Australia (that may be susceptible to Phytophthora dieback) it is essential to arrange a survey by an accredited Phytophthora dieback interpreter to determine the distribution of the pathogen across the proposed area of the operation. (The DEC or the Water Corporation's Environment Branch can provide a list of accredited interpreters). The results of the Phytophthora dieback survey may indicate one of the following scenarios:

- The area is entirely infested with Phytophthora dieback.
- The area is entirely free from Phytophthora dieback.
- The area is partially infested and partially uninfested with Phytophthora dieback.
- The area is uninterpretable due to absence of indicator species or recent disturbance.

An accredited Phytophthora dieback interpreter may recommend that a Dieback (hygiene) Management Plan (DMP) be prepared. The DMP may need to be approved by the DEC if it is a condition of approval. The DMP should include best practice management methods including:

- Demarcation showing clearly infected, uninfected and uninterpretable areas;
- Hygiene measures to be taken when machinery and vehicles have to cross dieback boundaries;
- Monitoring and reporting;
- Measures to be taken if a hygiene breach occurs; and
- Recommending that the works be carried out under dry-soil conditions, or ceasing work while moist soil conditions prevail.

It should be noted that dieback surveys are normally only current for a period of 12 months from the time that a survey is conducted. If the proposed works are not carried out within this period, then a resurvey may be necessary.

The management strategy will vary according to the relevant scenario. However, the greatest effort is required to ensure that sites that are currently uninfested remain free of the disease. The hygiene protocols for these four scenarios are shown in the table below.

Scenario	Hygiene Protocol
<i>Site is fully infested</i>	<ul style="list-style-type: none"> ▪ <i>Clean on exit</i>
<i>Site is dieback-free</i>	<ul style="list-style-type: none"> ▪ <i>Clean on entry</i>
<i>Site is only partially infested</i>	<ul style="list-style-type: none"> ▪ <i>Clean on entry to dieback-free areas.</i> ▪ <i>Clean on exit from infested areas.</i>
<i>Uninterpretable</i>	<ul style="list-style-type: none"> ▪ <i>Precautionary principle: clean on entry, clean on exit</i>

Below are a number of well-established *Phytophthora dieback* control measures that are an integral part of most DMPs. These should also be applied in the absence of a DMP.

- Where practical, schedule activities that involve soil disturbance for the (normally) dry summer months (November – March).
- Minimise the number of tracks that pass through native vegetation and ensure that the tracks are well drained (*Phytophthora dieback* impact is greatest in wet sites).
- Plan or alter tracks so they do not pass through the uninfested sections of native vegetation.
- If the location of the infestation is known, plan activities so they are completed in the uninfested parts of the native vegetation first, then move to the infested parts.
- Have the infection boundary marked with bright (survey) marking tape when undertaking works or activities, so the dieback free area is clearly demarcated.
- Avoid importing soil/sand/gravel. If it must be brought in, it should be tested for the presence of *Phytophthora cinnamomi*, or sourced from a supplier who provides *Phytophthora dieback* free materials, and transports and stores the materials hygienically (soil suppliers accredited by the Nursery Industry Association maintain high standards of hygiene).
- Do not move soil/sand/gravel in from the infested part of the bushland.
- During moist soil conditions, prevent vehicles and machinery from entering unless they are free of soil and mud. They should be restricted to hard, dry surfaces.
- Footwear should be free of mud and soil when entering native vegetation.
- Any water used in for construction (eg earthworks, water-binding, dust suppression) should be from a mains supply or sterilised with sodium hypochlorite.

While the DEC has developed a treatment regime involving phosphite (stem injection or aerial spraying of foliage), this is only suitable for relatively small areas involving susceptible threatened species, threatened ecological communities and threatened native fauna. The use of phosphite should not be regarded as a panacea for large areas.



Dieback Management Guideline (now known as Phytophthora dieback)

Document Revision History	