SOUTH EAST QUEENSLAND ECOLOGICAL RESTORATION FRAMEWORK:

GUIDELINE

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The South East Queensland Ecological Restoration Framework consists of three documents being the:

1. Code of Practice 2. Guideline 3. Manual

The Framework will be subject to periodic review. If you have any suggestions for improvement we invite your feedback.
Please provide feedback to SEQ Catchments, PO Box 13204, Brisbane, Qld, 4003.

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DISCLAIMER:

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Bushland Restoration Services

ON BEHALF OF:

Brisbane City — Dedicated to a better Brisbane

Gold Coast City Council

Redland City Council

Somerset Regional Council

SEQ Catchments — Healthy Land – Healthy Water

Logan City Council

Sunshine Coast Council

Moreton Bay Regional Council

Scenic Rim Regional Council

Lockyer Valley Regional Council

City of Ipswich

Toowoomba Regional Council

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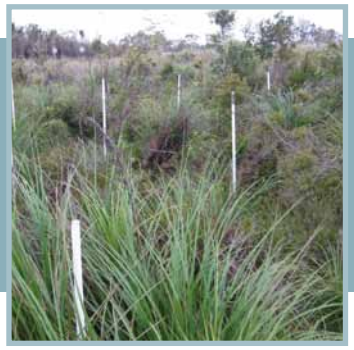
APPENDICES

1 INTRODUCTION

"Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."



1.1 PURPOSE OF SEQ ECOLOGICAL RESTORATION FRAMEWORK

The South East Queensland (SEQ) Ecological Restoration Framework Project was originally proposed by the Environmental Managers Technical Reference Group (EMTRG), a group of environmental managers representing SEQ Councils. The EMTRG recognised that the high growth experienced in SEQ, combined with the diversity of stakeholders undertaking ecological restoration, required the development of a standard to ensure consistent ecological restoration delivery. In April 2011, the Council of Mayors (SEQ) subsequently endorsed the Framework as a regional standard for undertaking restoration projects. Ultimately, ecological restoration projects delivered under the Framework will:

- Conserve and enhance biodiversity through increasing the extent and improving the condition of native vegetation;
- Ensure long-term environmental and economic sustainability; and
- Ensure ongoing improvement and maintenance of ecosystem services.

The SEQ region, as defined by the SEQ Regional Plan 2009 – 2031 is made up of 11 Local Government Areas, including:

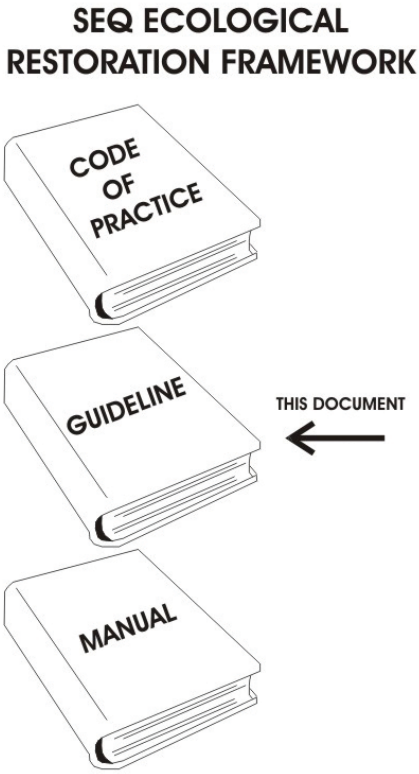
- Brisbane City Council
- Gold Coast City Council
- Ipswich City Council
- Lockyer Valley Regional Council
- Logan City Council
- Moreton Bay Regional Council
- Redland City Council
- Scenic Rim Regional Council
- Somerset Regional Council
- Sunshine Coast Regional Council
- Toowoomba Regional Council

The Framework is comprised of three key documents to guide the delivery of vegetation/ecological restoration works in the SEQ region including:

- **Code of Practice** – a policy document providing a head of power for the subsequent Guidelines and Manual. The code of practice reflects the SEQ policy environments where it is to be housed.
- **Guideline** – a decision making tool to guide users to the most appropriate course of action in their project. This document guides application of the policy and links to current best practice and examples demonstrated in the Manual element.
- **Manual** – a technical but easy to use guide to all aspects of ecological restoration. This document is reflective of current best practice, and provides the minimum acceptable solutions to ecological restoration.

1.2 THE GUIDELINE

This document constitutes the Guideline component of the SEQ Ecological Restoration Framework.



1.2.1 PURPOSE

This Guideline is designed to serve as a decision-making tool to assist environmental managers and practitioners to achieve the best possible outcomes when undertaking ecological restoration in South East Queensland. The Guideline is to be read and implemented in conjunction with the Code of Practice and Manual.

It is anticipated that the Guideline will be used in conjunction with management planning and planning processes that are already in place with local government and other agencies/ groups conducting ecological restoration.

1.2.2 APPLICATION

The Guideline applies to anyone undertaking ecological restoration works in SEQ, including but not limited to contractors and employees of local councils, other government organisations and utility providers, as well as volunteers, community groups and private landholders. This document can be used to inform policies and strategies implemented by local government.

1.3 WHAT IS ECOLOGICAL RESTORATION?

For the purpose of the SEQ Ecological Restoration Framework the definition of Ecological Restoration applied by the Society for Ecological Restoration International (SERI) has been utilised. Specifically:

> *"Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."*

The term ecological restoration embodies a wide range of activities that have been variously described as revegetation, rehabilitation, bush regeneration or native vegetation restoration. Although the term does not extend to landscaping or encompass all forms of planting per se, ecological principles can still be used to inform such activities.

According to the Society for Ecological Restoration International Science and Policy Working Group (2004), a restored ecosystem:

- Contains a characteristic assemblage of the species that occur in a reference ecosystem;
- Consists of indigenous local species to the greatest practicable extent;
- Contains all functional groups necessary for the continued development and/or stability of the restored ecosystem;
- Is capable of sustaining reproducing populations;
- Functions normally for its ecological stage of development;
- Is suitably integrated into a larger ecological landscape;
- Potential threats to the health and integrity of the restored ecosystem have been eliminated or reduced as much as possible;
- Is sufficiently resilient to endure normal periodic stress events in the local environment; and
- Is self sustaining to the same degree as a reference ecosystem.

These themes are embodied in the SEQ Ecological Restoration Framework's Code of Practice:

Ecological Restoration Policy Statement -

1. *Restored ecosystems incorporate assemblages of species reflecting those in reference ecosystems and have the potential to recruit further species by natural means;*
2. *Restored ecosystems support the same structure and function as reference ecosystems;*
3. *Restored ecosystems consist of indigenous species of local provenance to the greatest extent practicable. That is, exotic and invasive species that would otherwise degrade ecosystem health are absent;*
4. *Restored ecosystems are self sustaining to the same degree as a reference ecosystem, such that they are resilient to normal periodic stress; and*
5. *Restored ecosystems interact with the surrounding landscape and contribute to ecosystem services.*

The emphasis for this Guideline is on ecological restoration of ecosystems. In SEQ our ecosystems are diverse, ranging from highly modified waterways in urban areas to near pristine habitats in rural and remote areas. Ecological restoration can be undertaken using many techniques, with the major approaches being outlined in section 2.3. Although this Guideline nominally deals with the topic of ecological restoration, it is important to note that the issues of restoring 'ecosystems' are much broader, and deal with many more components, than vegetation alone. Topics not directly related to vegetation management, such as fire management, control of feral animals and alterations to natural hydrological systems, are not specifically addressed in this Guideline. These matters are to be addressed as part of a holistic approach to ecological management in the site assessment process.

2 ECOLOGICAL RESTORATION

"It is impossible to create something as complex and irreplaceable as a functioning natural ecosystem from nothing."

2.1 WHY UNDERTAKE ECOLOGICAL RESTORATION?

Ecological restoration is an activity undertaken by humans that attempts to reinstate attributes of ecosystems that are considered to be of value. Activities that achieve these desired attributes are likely to include the control of environmental weeds, the re-establishment of wildlife corridors or streambank stabilisation, to list but a few. As society's values change, so too will the aims and objectives of ecological restoration. Generally, however, the desire to maintain the integrity of our natural environment and improve the ecological function of areas previously subjected to disturbance remains constant.

The ultimate test for determining the success of ecological restoration practices will be whether a self-sustaining ecosystem can be created or reinstated. Importantly, ecological restoration techniques emphasise the reinstatement of natural processes, and do not merely attempt to create an artificial landscape through the reintroduction of endemic plants and animals. Although reintroductions may be necessary in the process of restoration, doing so without consideration of the complex interactions between ecosystem biotic and abiotic components will result in a static and non-functioning representation of nature.

Proponents of ecological restoration are aware that it is impossible to create something as complex and irreplaceable as a functioning natural ecosystem from nothing, and recognise the importance of protecting and maintaining the native vegetation that remains.

This said, aspects of ecological restoration can permeate all projects relating to vegetation management and establishment. For example, the use of local species in urban landscapes can assist in providing habitat values and prevent the further introduction of weeds into natural systems. In such circumstances the Ecological Restoration Guidelines can be adopted as a tool to achieve the best possible environmental outcome.

2.2 WHY INTERVENE?

It is a commonly held belief that a pristine, unspoiled, "wild" ecosystem can only be one which has not been affected or disturbed by humans. This is not the case. The long-standing inextricable inter-relationship between humans and the environment must be recognised. Many of our natural environments, while appearing untouched, have actually been shaped and influenced by the actions of humans over long periods of time. For example, the use of fire by Aboriginal Australians over tens of thousands of years has helped create the predominantly sclerophyllous vegetation that exists in our country today. The significant impact that humans continue to have on the functioning of the natural environment must not be discounted.

It must also be recognised however, that in most situations, human activity has led to a decline in the structure and function of our natural ecosystems, with adverse consequences for many species. In order to protect environmental values and ecosystem services it has become necessary to take direct action that will maintain maximum biodiversity and ecological functioning, while reducing or eliminating threats to these natural processes. In recognition of this, the fields of ecological restoration

(the practical component being addressed in these Guidelines) and restoration ecology (the science that informs practice) have grown greatly over the past two decades.

If we are going to intervene, we need to ask ourselves the question – what state do we want to restore this ecosystem to? It is essential to have a clear idea of what is ideal and feasible, taking into account the fundamental role that humans play in the functioning of the environment.

Certainly, careful evaluation of the potential benefits to be gained from ecological restoration projects is essential, in order to avoid under-utilisation of time and resources. Ecosystems are complex and dynamic, and as such we are refining new approaches to management and ecosystem restoration. Decisions therefore need to be based on the best available knowledge at the time of planning and implementing an ecological restoration project.

The outcomes of ecological restoration are many and support the objectives of many environmental themes including water quality management, biodiversity conservation, ecosystem services, to name but a few.

2.3 APPROACHES TO ECOLOGICAL RESTORATION

Choosing the appropriate approach to ecological restoration relies heavily on an understanding of the type and extent of damage to the original ecosystem. This understanding will assist in determining whether only minor inputs are required (e.g. control of harmful weeds) or whether substantial alteration of physical attributes of the landscape are needed to restore an ecosystem (e.g. reinstating overland flow paths).

Current restoration theory and practice indicates that ecosystems pass through a series of transitional states as they move from an intact to a degraded condition or visa versa (Hobbs, 2007; Suding & Hobbs, 2009; & Cramer *et al*., 2008). Systems move from one state to the next when thresholds are passed, as graphically illustrated in Figure 1 below.

An understanding of whether biotic (e.g. weed invasion) or abiotic (e.g. loss of topsoil) thresholds have been crossed will assist in identifying the most appropriate approach. The example in Figure 2 (over page) illustrates how the biotic and abiotic influences may physically manifest in an ecosystem.

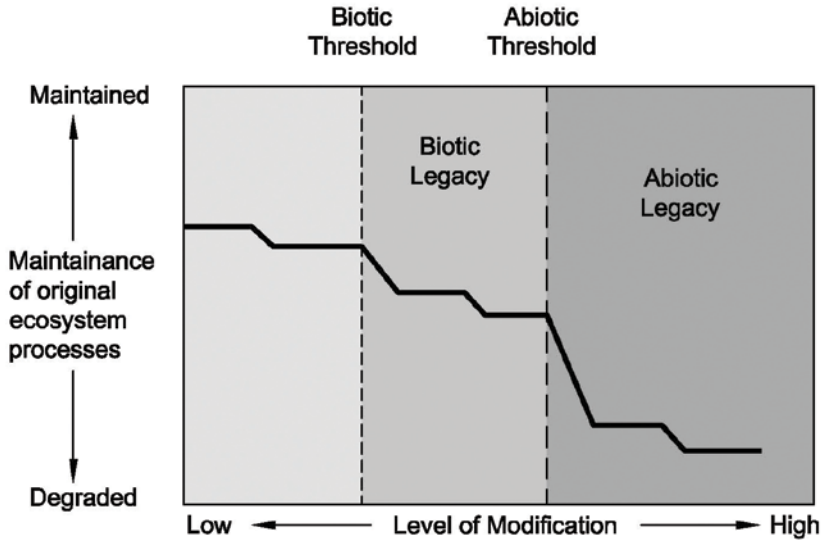


Figure 1 – Graphical representation of ecosystem transitional states (adapted from Cramer *et al*., 2008)

Figure 2 – illustration of systems passing biotic and abiotic thresholds

An intact waterway

A waterway that is degraded with weeds but supports native elements may have passed through a biotic threshold.

A waterway that supports only weeds, has a modified profile and modified flows, is likely to have passed an abiotic threshold.

The ability of an ecosystem to naturally recover decreases as these thresholds are crossed. The most appropriate ecological restoration approach can therefore only be established once two key factors are considered:

1. The natural regeneration capacity present i.e. resilience potential; and
2. The level and type of disturbance, degradation or damage that has occurred.

The combination of these two factors will decide to a large extent which of the four commonly used restoration approaches will be utilised on a site.

Often, a vegetation remnant that has already been recognised as having values worthy of protection status will be best suited to the assisted natural regeneration approach. A protected ecosystem will usually have at least some native vegetation cover, with the strong likelihood of assisted natural regeneration occurring. This is primarily accomplished through the control of environmental weed species present, which may have reduced the function and structure of the ecosystem by suppressing native plant regeneration and competition for light, nutrients, space and water. Natural regeneration may take place due to the presence of a stored seed bank in the soil, or by easy reintroduction of native seeds through the actions of birds, bats and other animals, and/or by wind and water dispersal of seeds.

In practice, where there is the likelihood that native species will occur, the preferred option should always be assisted natural regeneration (where possible) as this results in the most cost-effective ecological outcomes. The ecological benefits of assisted natural regeneration when compared with planting can often include the recruitment of species directly from local communities, recruitment of species that are not traditionally propagated and greater structural complexity in a shorter period of time. These concepts are graphically illustrated in Figure 3.

Planting is frequently a more expensive option and may not provide the most optimal results. Planting should be used only where it

Table 1. Four common restoration approaches (modified from McDonald, 2006).

ECOLOGICAL RESTORATION APPROACH	CIRCUMSTANCES WHERE APPROPRIATE	EXAMPLES
Natural regeneration	Where resilience is intact and recovery is automatic with the removal of the cause of the damage.	Where fencing to exclude stock enables natural regeneration of plants.
Assisted natural regeneration	Where degrees of resilience exist and "triggering" interventions (either disturbance or resource provision[1]) can affect recovery by natural regeneration.	Where lantana and exotic groundcovers affect a rainforest understorey.
Reconstruction	Where resilience is depleted, and abiotic or biotic elements need wholesale importation or major amendment before recovery can commence.	Where native vegetation has been removed and is not naturally recruiting, but site topography remains unchanged.
Fabrication (Type conversion)	Where conditions are permanently changed and better-adapted local systems can be regenerated or constructed to restore integrity to the landscape.	Where topography has changed so drastically, that the original ecosystem can no longer be re-established on the site.

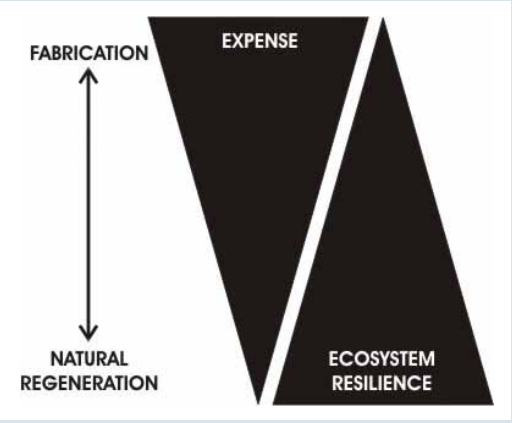
[1] *Resource provision may include fencing, but is unlikely to include planting.*

can be demonstrated that the soil seed bank is insufficient to allow natural regeneration to occur (for example, by experimenting with disturbance techniques[2]). However, there may be times where the environmental and financial benefits of introducing planted stock is greater than waiting for natural recruitment, for example where an area is actively eroding.

There are other benefits to planting that relate to community engagement. One of the most pertinent means by which individuals can feel they are making a contribution to the environment is by planting a tree. Tree plantings are frequently the first point of engagement with the community and provide an opportunity to introduce them to further, more complicated issues such as weed management. Nonetheless, in all instances ecological aims must be pursued and planting solely for the purpose of community engagement compromise these aims.

Refer to the next section of the Guideline for specific details on how to determine which restoration approach suits a particular site best.

Figure 3 - Conceptual illustration of the benefits of Assisted Regeneration versus Fabrication



[2] *Note that when discussing ecological restoration methods, 'disturbance' can be a natural component of ecological functioning and the first phase in the successional process. For example, the fall of a large tree in a sub-tropical rainforest or a lightning strike causing fire in a sclerophyll forest would both be considered disturbance.*

3 DECISION MAKING

"The question 'Are native plants regenerating? If not, do you think they will?' is a critical step when deciding the correct approach and relates to the resilience of the ecosystem."

3.1 OVERVIEW OF ECOLOGICAL RESTORATION APPROACHES

Accepted approaches to ecological restoration are provided in Table 2. The restoration approach chosen will be dependent on the degree of habitat disturbance and degradation, the anticipated potential of habitats to recover, successional change and the aims and objectives of the ecological restoration project.

Sometimes a combination of approaches is required. For example, when remnant native vegetation is surrounded by cleared and degraded lands, an assisted natural regeneration approach is appropriate for the remnant and a reconstruction approach for the surrounding lands. If increased storm water run-off is a threat to the recovery of these areas, it may be necessary to establish a wetland plant community (fabrication) that will slow run-off and increase nutrient uptake, thus improving the quality of water entering a natural area. There are times where the use of reconstruction planting is necessary to counter abiotic affects, for instance the use of buffer plantings to rapidly seal edges of isolated remnants or to enhance the re-establishment of landscape connectivity.

Table 2. Application of restoration approaches.

NATURAL REGENERATION	
Applies:	• To relatively large, intact and weed-free areas of native vegetation. • Where native plants are healthy and capable of regenerating without human intervention. • When native plant seed is stored in the soil or will be able to reach the site from nearby natural areas, by birds or other animals, wind or water. • Where the plant community has a high potential for recovery after any short-lived disturbance, such as a fire or cyclonic winds. • When preventative action is all that is required to avert on-going disturbance e.g. erection of fencing to prevent intrusion by cattle.
Role of planting:	• Planting in such areas can work against the aims of restoration by interfering with natural regeneration.
Goal vegetation community:	• The re-establishing plant community will be similar in structure, composition and diversity to the original vegetation.
ASSISTED NATURAL REGENERATION	
Applies:	• To natural areas where the native plant community is largely healthy and functioning. • When native plant seed is still stored in the soil or will be able to reach the site from nearby natural areas, by birds or other animals, wind or water. • Where the natural regeneration processes (seedling germination, root suckering, etc.) are being inhibited by external factors, such as weed invasion, soil compaction, cattle grazing, mechanical slashing, etc. • When limited human intervention, such as weed control, minor amelioration of soil conditions, erection of fencing, cessation of slashing, etc. will be enough to trigger the recovery processes through natural regeneration. • When the main management issue is weed infestation and/or current land use practices.
Role of planting:	• Planting in such areas can work against the aims of restoration by interfering with natural regeneration except where species cannot return to site without direct intervention.

Table 2 cont'd

Goal vegetation community:	• The re-establishing plant community will be substantially similar in structure, composition and diversity to the original vegetation.
RECONSTRUCTION	
Applies:	• Where the site is highly degraded or altered. • When the degree of disturbance has been so great and long-standing that the pre-existing native plant community cannot recover by natural means. • To sites such as areas of fill, sites affected by stormwater flow, areas that have been drastically cleared, even though there may be a few remaining native trees or shrubs. • When a greater degree of human intervention is required, such as weed control, cessation of grazing and/or slashing, amelioration of soil conditions such as importation of soils, drainage works or re-shaping of the landscape.
Role of planting:	• Importation of native species to the area is required, either through planting or direct seeding (in some situations). Natural regeneration and recruitment is insufficient to initially re-establish the original vegetation. Depending on the prevailing circumstances, the planting of a broad diversity of species from the target ecosystem may be unnecessary and the use of pioneers may be sufficient to re-establish ecological processes.
Goal vegetation community:	• The re-establishing planted community should be similar to the original vegetation in structure, composition and diversity.
FABRICATION (TYPE CONVERSION)	
Applies:	• Where site conditions have been irreversibly changed. • When it is not possible to restore the original native plant community. • Where a better-adapted local plant community can be planted that will function within the changed conditions. • In situations such as the construction of a wetland plant community to mitigate increased urban storm-water run-off.
Role of planting:	• Revegetation (planting) is the major component in a fabrication program.
Goal vegetation community:	• The re-establishing planted community should be similar to a naturally occurring plant community of the same type (e.g. a constructed freshwater wetland should resemble a natural system in terms of structure, composition and diversity).

(Table 2 adapted from a table in the Gold Coast City Council's "Guideline for the preparation of a Rehabilitation Plan")

3.2 HOW TO DECIDE WHICH RESTORATION APPROACH BEST SUITS THE SITE?

The flowchart over page (Figure 4) is a simple, easy-to-use guide to help with the decision about which of the four ecological restoration techniques are best suited to a particular site, or portions of a site. Most of the questions in the flowchart deal with assessing the amount of disturbance that has occurred at the site, from causes such as clearing, modified soil conditions and presence of environmental weeds. The natural regeneration capacity (i.e. resilience potential) is also covered briefly in the flowchart, and this topic is dealt with in further detail over.

The question "Are native plants regenerating? If not, do you think they will?" is a critical step when deciding the correct approach and relates to the resilience of the ecosystem. Resilience is the ability of an ecosystem that has suffered harm from stress or disturbance to regain structural and functional attributes. Resilience potential is one of the key factors that determine whether a site will be able to recover from disturbance naturally, or if more active intervention, such as weed control or planting, will be required. But how do we evaluate resilience potential, particularly when there is no evidence that native plants are regenerating? One simple hands-on technique is to subject a portion of the site to disturbances that

mimic the disturbances that the particular vegetation community is naturally adapted to. Observation of the results of the disturbance (i.e. the regeneration of both native and weed species) will give a good indication of the resilience potential that is present. Following are some examples of "triggering" techniques that can be trialed:

- Removal of competition by environmental weeds. This is the most important approach;
- Light soil disturbance (e.g. raking, hoeing, ripping) to trigger germination or resprouting;
- Fire or fire substitutes for fire-adapted vegetation types (e.g. grass fires, debris pile burns, smoke treatment); and/or
- Hydrological amendment in wetlands (e.g. draining or flooding amendments, flushing or salinity amendments) (McDonald, 2006).

As it is highly likely that weeds as well as natives will be triggered by the intervention, it is imperative to undertake careful and consistent weed control.

When deciding on the correct approach, structure of the existing system also needs to be taken into account. For example, the structure presented by a camphor laurel forest would warrant a significantly different approach to that presented by an exotic pasture.

Selecting an inappropriate restoration approach for the site may result in costly and time-consuming errors being made. Undertaking expensive reconstruction works at a site where there is adequate natural regeneration is not a good use of resources and may negatively impact on the ecological integrity of the site. Conversely, minimal intervention on a site in the unfounded expectation that regeneration will occur, means that the recovery of the vegetation community will be held up significantly.

Detailed site assessments are essential for all successful ecological restoration projects as this will inform all decisions made throughout the life of the project, including which restoration approach to utilise.

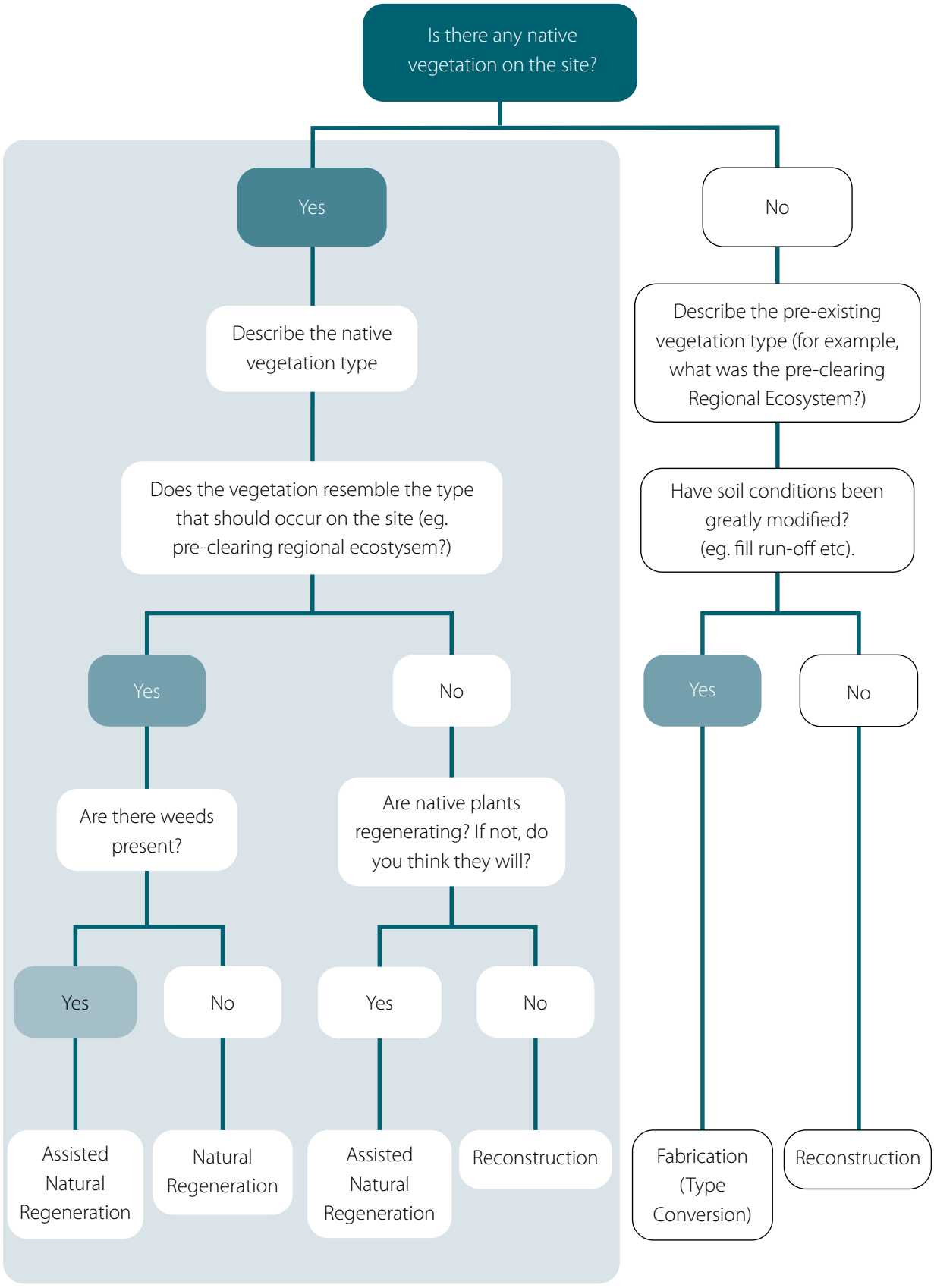
3.3 SITE CONSIDERATIONS

Site assessments are vital to identify the most appropriate approach to ecological restoration for any given project. Sections 4 and 5 of the Guidelines identify how to plan a project and the fundamental information that must be considered when developing a plan.

Broadly, most ecological restoration projects aim to restore "natural" vegetation communities. However, in some instances there may be other site considerations that mean the establishment of "natural" vegetation communities is not practical or desirable. For instance, ecological restoration in urban waterways frequently needs to take into account the impact of vegetation on stream flows and consequential flooding. It therefore may not be possible to restore such areas to resemble the full floristic and structural composition of reference sites. In these circumstances the approach adopted should be to restore the ecosystem to the greatest practicable extent. Similarly, Crime Prevention Through Environmental Design (CPTED) principles, such as pathway lighting, may need to be adopted on some sites.

Site assessments must therefore consider any such compromises that must be made. Where compromises are made, the judicial use of plantings may have great environmental benefit even if the full complement of plant species from the reference community cannot be reinstated.

Figure 4 – Selecting the appropriate restoration approach



4 PROJECT PLANNING

"Detailed site assessments are essential for all successful ecological restoration projects as this will inform all decisions made throughout the life of the project, including that of which restoration approach to utilise."

4.1 WHAT TIMEFRAMES ARE INVOLVED?

Most ecological restoration projects require long term commitment. In most instances at least 2-5 years are required to ensure the success of a project, but timeframes depend on specific circumstances and periods of 10 years or longer may be required. Ongoing maintenance is an essential factor in ecological restoration and the key to long term success. This commitment should be considered upfront as it has bearing on your capacity to fund and/or undertake a project.

4.2 IS THERE EXISTING INFORMATION?

An important first step when planning for a project is to obtain any information which is already available about the site. Desktop searches can provide valuable data on threatened flora and fauna species, vegetation communities found at or within the vicinity of the site and provide guidance as to the vegetation communities that once occurred on sites that are now cleared. Many of these resources are available online or can be obtained through Department of Environment and Resource Management (DERM) or local government authorities. It is recommended to reference the current and best information available by checking its currency with the relevant local government. These searches may include, but are not limited to:

- Local Area Plans / Conservation Management Plans;
- HerbRecs database (DERM);
- CORVEG database (Queensland Herbarium of DERM);
- Remnant and pre-clearing Regional Ecosystem (RE) mapping (DERM);
- Essential Habitat (DERM);
- Regrowth mapping (DERM);
- Wildlife online (DERM);
- Wetland mapping (DERM);
- Biodiversity Planning Assessment Mapping (DERM);
- Back on Track species information (DERM);
- NRM Plan Atlas;
- Recovery plans;
- Council's mapping;
- Local government departments;
- Restoration plans for nearby sites;
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) Online Protected Matters Search Tool database to identify scheduled Threatened Ecological Communities and species;
- State's koala mapping (DERM);
- Other listings of significant species occurring locally and regionally; and
- Aerial photography, historical aerial photography and satellite imagery.

Local knowledge can also be a valuable resource when first gathering information about a site. Consider consulting catchment or bushcare groups, specialist groups or local regeneration contractors.

4.3 WHAT LAWS AFFECT THE PROJECT?

Ecological restoration projects are sometimes undertaken in direct response to a statutory requirement. For these projects the SEQ Ecological Restoration Framework do not aim to replace the specific requirements of statutory ordinances but rather complement their intended outcomes. For example, a proposed vegetation offset provided in response to the *Vegetation Management Act 1999* and its related policies will still need to meet the requirements of the current policy for vegetation management offsets administered by DERM.

A summary of key documents guiding restoration outcomes in SEQ is provided in Appendix A of the SEQ Ecological Restoration Code of Practice.

Irrespective of the driver for an ecological restoration project, it is still necessary to comply with other statutory requirements in its delivery. The planning and implementation of ecological restoration will at a minimum need to consider the statutory requirement listed in Table 3. Although these represent some of the current major legislation it is recommended to check with the relevant local government to assist in identifying any other legislative requirements.

Table 3. Some statutory considerations.

ORDINANCE	RELEVANCE
Workplace Health and Safety Act 2011	The *Workplace Health and Safety Act 2011* is about making workplaces and work practices safer for everyone. The Act sets out the laws about health and safety requirements affecting most workplaces, work activities using specified high risk plant in Australia. It seeks to protect your health and safety and the health and safety of everyone at a workplace, while undertaking work activities or using specified high risk plant. Some aspects of ecological restoration involve risks and as such familiarity with the Act is necessary in order to understand personal obligations and safety requirements. Broadly, for ecological restoration projects there is a need to conduct a risk assessment. Those involved with ecological restoration should have an understanding of first aid procedures.
Aboriginal Cultural Heritage Act 2003	The *Aboriginal Cultural Heritage Act 2003* requires individuals and organisations to take all reasonable and practicable measures to ensure activities do not harm cultural heritage. Artefacts of cultural significance may not be immediately apparent when planning a project and for this reason projects should plan for the inadvertent uncovering of such items. Specifically the Duty of Care Guidelines associated with the Act notes that *"if at anytime during the activity it is necessary to excavate, relocate, remove or harm a Cultural Heritage Find the activity should cease immediately".*
Land Protection (Pest and Stock Route Management) Act 2002	The *Land Protection (Pest and Stock Route Management) Act 2002* imposes a legal responsibility for control of declared species categorised under the Act by landowners. Some local governments require the control of weed species declared within the local government area.
Fisheries Act 1994	For some projects there may be the requirement to either prune or translocate marine plants for the purpose of ecological restoration in areas subject to tidal inundation. Marine plants are protected under the *Fisheries Act 1994* and as such a permit is required should translocation be identified as a project requirement.

Table 3 cont'd

ORDINANCE	RELEVANCE
Nature Conservation Act 1992	All native plants are regarded as "protected plants" under the *Nature Conservation Act 1992*. The Department of Environment and Resource Management (DERM) administers the Act to ensure that protected plants (including whole plants, plant parts and seeds) are not illegally removed from the wild or traded. The harvesting and use of most protected plants (including whole plants, plant parts and seeds) from the wild is regulated by a licensing system. Persons who wish to harvest protected plants from the wild for any purpose are required by law to obtain a licence, permit or authority from DERM or have an exemption under a regulation or conservation plan. A licence or authority may also be required to propagate or sell protected plants.
Environment Protection and Biodiversity Conservation Act 1999	Ecological restoration can be triggered as an action resulting from implementation of the Act. Ecological restoration activities should be done in accordance with the requirements of the Act in that matters of national significance are not adversely affected.
Vegetation Management Act 1999	Ecological restoration can be triggered as an action resulting from implementation of the Act. Ecological restoration activities should be done in accordance with the requirements of the Act in that remnant native vegetation is not cleared.
Water Act 2000	Ecological restoration can be triggered as an action resulting from implementation of the Act.
Local ordinances and Planning Schemes	Some local governments enforce local laws relating to the protection of vegetation. The requirements of each local government vary and it is therefore best to check with a local government their specific requirements at the time of planning a project.

4.4 UNDERTAKING A SITE ASSESSMENT

No decisions can be made regarding a site or the proposed Ecological Restoration Plan without a thorough site assessment. The background searches, as outlined above, only gives part of the information necessary to make good decisions. The bulk of knowledge regarding a site can only be obtained by spending a substantial period of time investigating the attributes of the site on ground. During the planning stages of ecological restoration, resources should be allocated to allow a detailed site assessment, including aspects such as access points, vegetation communities, environmental weed species present, habitat values, and landscape connectivity. Section 5.3 outlines the required content of Ecological Restoration Plans and identifies the specific information that needs to be collected during a site assessment.

4.5 WHAT IS THE REFERENCE ECOSYSTEM?

The Society for Ecological Restoration International (SERI) recommends the selection of a reference ecosystem (also known as a reference community) to facilitate development of restoration objectives and to serve as a comparison for evaluating the completed project. A reference ecosystem is ideally undertaken in the same vegetation community as the project site but represents an area that has been subject to minimal past disturbance.

The best practice approach to defining vegetation communities is to utilise Regional Ecosystems as the standard. However, it is important to note that Regional Ecosystems were developed to describe vegetation communities at a regional scale. As such, when considering reference sites it is important to acknowledge the variability within a Regional Ecosystem at the local scale. Eyre *et al.*, (2006) notes with regard to reference sites:

> *…areas to be assessed should be compared with a reference site that occurs as close as possible to the area to be assessed and has similar environmental conditions, i.e. the same regional ecosystem, vegetation community, similar climate (same subregion), similar landscape conditions (soil, slope, position in the landscape, geology etc) and similar natural disturbance (cyclone impacts or fire history).*

Eyre *et al.*, (2008) refers to reference sites as those that are Best on Offer (BOO) sites, given few ecosystems are totally free of the effects of threatening impacts. Consideration should be given to the history of the reference site and what influence this has had on the species assemblage and structure. For example, a site subject to regular burning will have a different assemblage, and potentially structure, to a similar site that has not been burnt in several years as illustrated by way of example in Figure 5.

Therefore, reference sites need to be carefully selected and species and structural data collected from reference sites will require some interpretation. In some instances several sites will need to be selected as the reference ecosystem in order to consider the range of variability that is representative of the ecosystem that is to be restored.

In summary, the reference ecosystem should be located in close proximity to the restoration site, have similar abiotic features and be in good condition with low levels of disturbance. Methods for assessing reference ecosystems are identified in the Manual.

Figure 5 - Illustration of variability within an ecosystem

Regional ecosystem 12.8.8 with a grassy understorey – the likely outcome of previous fire events

Regional ecosystem 12.8.8 with a rainforest understorey – the likely outcome of absence of fire.

4.6 WHAT OTHER ECOLOGICAL VALUES SHOULD BE CONSIDERED?

Section 1.3 of this Guideline notes issues of restoring 'ecosystems' are much broader, and deal with many more components than vegetation alone. Although addressing all issues is beyond the scope of the Ecological Restoration Framework, there are some ecological values that are regularly identified as important in SEQ and drive the need for ecological restoration.

Some common examples include:

- Restoration of habitat for fauna. Many fauna species have specific habitat requirements, for example koalas require feed trees, gliders require suitably spaced trees to enable movement throughout their habitat range and butterflies, such as the Richmond Birdwing, are dependant on specific 'host' plant species in order to sustain their population. Although reference sites may not include these specific attributes, there will be times when their integration in a project is necessary to meet other project objectives and prevent the regional or local decline and/or promote the recovery of a fauna species;
- Habitat boxes. Hollows generally take decades to form in trees. Where ecological restoration projects are devoid of hollows, there may be a need to integrate habitat boxes into project design to prevent the regional or local decline and/or promote the recovery of a fauna species; and
- Pools and Riffles. This is most likely to be relevant to the fabrication method of ecological restoration projects in waterways. Pools and riffles are important to the health of waterways including the diversity of flora and fauna species within them. Indeed without presence of pools and riffles in a waterway some plant species included in an ecological restoration project would fail to establish.

4.7 DEFINING SUCCESS?

4.7.1 PROJECT AIMS AND OBJECTIVES

The project aim is a broad, overarching statement that describes a general direction for the project and helps to clarify our aspirations. For ecological restoration projects the aim could be simply stated as:

> *"To restore the structure, composition, function and dynamics of the pre-existing ecological communities to the highest practicable extent." (SERI, 2004)*

Project objectives are measurable and identify the broad steps needed in order to achieve the aim. It is appropriate to have more than one objective for a site and objectives will vary according to the requirements of the site and the vegetation community or communities to which the site belongs. An example of a project objective for a project involving the assisted natural regeneration of sub-tropical rainforest may be:

> *"Ecologically sound rehabilitation and expansion of core remnant and regrowth patches."*

An example of a project objective for a project involving the fabrication of a wetland may be:

> *"Establishment of an artificial wetland that provides habitat for a diversity of native fauna."*

More examples of project objectives are provided in Appendix A.

Broadly, objectives should be SMART (Doran, 1981):

- **Specific** - Be precise about what you are going to achieve.
- **Measurable** - Quantify your objectives.
- **Achievable** - Are you attempting too much?
- **Realistic** - Do you have the resources to make the objective happen (time & dollars)?
- **Timed** - State when you will achieve the objective (within a month? By February 2018?).

4.7.2 PERFORMANCE INDICATORS

Performance Indicators provide very clear goals and are used to determine whether the aims and objectives of the ecological restoration plan are being met. Each Performance Indicator should be aligned with objectives that must be SMART in order to allow monitoring and evaluation at regular intervals. Performance Indicators will be site specific and will depend on the type of habitat being restored. For example, Performance Indicators for plant growth rates and vegetative cover for reconstruction of a riparian rainforest community growing on rich alluvial soils will not be the same as for reconstruction of a coastal Banksia forest growing on sand - differing environmental factors and abiotic conditions in these habitats will affect the rate of plant growth.

Given the diversity of ecological restoration projects undertaken in the region, it is not possible to identify standard Performance Indicators that should be adopted on all projects. However, it is important that Ecological Restoration Plans (ERP) clearly articulate the project specific Performance Indicators each aligned with measurable objectives and the time at which the objectives will be measured. Ideally these will be presented in a table format.

This said, Performance Indicators can in part be derived from information attained from the reference site. For example, minimum Performance Indicators derived from reference site data, where planting is required, may include:

- 100% of species planted have been recorded in the reference site; and
- All structural layers are presented in restoration.

Refer to Appendix A for example Performance Indicators.

4.7.3 MINIMUM ACCEPTABLE SUCCESS CRITERIA

The Performance Indicators provide a set of targets which will determine the minimum acceptable success criteria of the project. These indicators should be realistically achievable over the period of the project. Provisions must be made for "adaptive management" which will allow for flexibility in unforeseen circumstances e.g. drought, fire or floods.

4.8 UTILISING BEST PRACTICE TECHNIQUES

The Guideline component of the SEQ Ecological Restoration Framework only identifies how to approach the planning of ecological restoration whereas the Manual component is the 'how to guide' to implementation. ERPs need to articulate the specific techniques to be applied within a site. Frequently multiple techniques will be required for any one site as dictated by the prevailing site conditions. Ascertaining the most appropriate technique will only be possible following site assessment / development of an ERP and review of the relevant sections of the Manual.

5 PREPARING AN ECOLOGICAL RESTORATION PLAN

"Establish the project Goal, the Aims, the Objectives and Performance Indicators early in the preparation of the plan."

5.1 WHAT IS AN ECOLOGICAL RESTORATION PLAN?

An Ecological Restoration Plan (ERP) is a site-specific document that provides guidance on the ecological restoration and ongoing management of an area utilised by native flora and fauna.

A good quality ERP will:

1. Provide sufficient background information and site details to justify the proposed works;
2. Clearly describe specific ecological restoration and management objectives required to meet each Performance Indicator;
3. Outline approaches, methodologies and techniques for the site restoration works;
4. Provide details of ongoing monitoring requirements including measurable outcomes; as well as
5. Have contingency planning options in the case of system failure or natural events which hinder progression.

In some instances a full report may not be required and a scaled plan may be sufficient to document and relay all relevant information. However, it will be necessary to check with the relevant local government as to their preferred format if the plan is to be submitted for approval.

All ERPs will aim for improved environmental outcomes and must be consistent with existing natural resource management legislation and policy, including the principles of Ecologically Sustainable Development.

5.2 WHO SHOULD PREPARE AN ECOLOGICAL RESTORATION PLAN?

A restoration ecologist or an individual with adequate training, skills and experience in the area of restoration should be responsible for the drawing up of the restoration plan and, if possible, the overseeing of its implementation. Relevant qualifications may include a Certificate in Conservation Land Management - Natural Area Restoration from a TAFE college and/or a university degree in a related field such as ecology or vegetation management. It is advantageous to select a restoration ecologist who is experienced in the particular vegetation type that is to be restored e.g. wetland or rainforest and has had previous 'hands on' experience. Engaging the services of someone that has an affiliation with a recognised professional body and has specific skills in ecological restoration plans will assist in ensuring there is greater project ownership and quality control. Examples include:

- Environment Institute of Australia and New Zealand (EIANZ) accredited professionals;
- Practicing members of AABR (Australian Association of Bush Regenerators); and
- Practicing members of Society of Ecological Restoration International (SERI).

SERI suggests that just one individual be given leadership of the project (with delegating powers) in acknowledgement of the complex nature of restoration, which often requires that numerous decisions be made in the course of adaptive management.

5.3 BEFORE YOU START

Project planning as per Section 4 is a mandatory step before proceeding with preparing the restoration plan. It will be necessary to establish the project aim, objectives and performance indicators early in the preparation of the plan.

Time frames to meet Performance Indicators must also be established early in project design. These must be realistic in terms of what can be achieved within the project and balanced with the time frames necessary to achieve ecological outcomes.

Reference should be made to other reports prepared for the restoration project such as Ecological Assessment Reports (e.g. prepared in accordance with council policies/requirements). Although such documents may provide valuable information, it is likely the ERP will require additional site assessment and further detail than is provided in a typical Ecological Assessment Report.

5.4 SCOPE AND CONTENT OF AN ECOLOGICAL RESTORATION PLAN

This section provides a template for the scope and content expected in most ERPs. There will be instances where not all sections are required in an ERP, conversely, complicated ERPs may require additional sections and/or more detail.

5.4.1 TITLE, AUTHOR AND DATE

The title should clearly articulate the location of the project, the author (including their qualifications) and the date of its preparation.

5.4.2 BACKGROUND

A short statement explaining the rationale for the project should be prepared.

5.4.3 PHYSICAL SITE DESCRIPTION

A brief description of the site, including:

- Site name, descriptor (Lot/RP(s)) and location;
- Land tenure and zoning;
- Management body;
- Size and shape of the site;
- Geology and soils (e.g. describe topsoil, soil profile and soil health – you may need to undertake soil tests);
- Aspect, topography and hydrology;
- Climate;
- Context – e.g. is it located in a mapped corridor;
- Site features – e.g. waterways and drainage features, buildings, roads, tracks, access and other infrastructure;
- Site history – e.g. when the land was settled, logging and/or clearing history, access, previous land uses and activities;
- Neighbours/stakeholders; and
- Current land use(s), both on site and in the surrounding area.

5.4.4 AIMS AND OBJECTIVES

Refer to Section 4.7 "Defining Success".

5.4.5 SITE PLANS

One or more thematic maps of the site should be presented in the ERP. At least one map should be overlaid on an aerial photograph with the following standard features and supporting text:

- Title and date;
- Scale and orientation;
- Legend;
- Cadastral boundaries; and
- Key features – e.g. roads and waterways.

Essential thematic layers include:

- Vegetation communities and/or Regional Ecosystem and/or Pre-clearing Regional Ecosystem mapping (at the property scale);
- Relevant planning or physical constraints;
- Details of existing and proposed development;
- Significant plant locations and fauna habitat features;
- Management zones; and
- Photo monitoring point locations.

5.4.6 SITE CONSTRAINTS

The ERP should specify any relevant planning, legal, physical or other constraint(s) that may affect management of the site. This includes but is not limited to:

- Easements and restrictions on title;
- Site access;
- Location of services and other infrastructure (including future infrastructure plans where they exist);
- Zoning provisions;
- Bushfire asset protection zones;
- Development controls and policies;
- Provisions of relevant statutes - e.g. *Nature Conservation Act1992, Sustainable Planning Act 2009, Vegetation Management Act 1999*;
- Sites of Aboriginal or European cultural heritage;
- Physical constraints such as slope, acid sulphate soils, streambank stability and flooding; and
- Contaminated land.

5.4.7 VEGETATION COMMUNITIES ON THE SITE

The ERP should include detailed mapping and descriptions of existing vegetation communities at the site, including Regional Ecosystem mapping. Vegetation should be described according to the structure and floristics of each stratum. Vegetation descriptions should include details of current vegetation condition, including a description of the density and distribution of weed species in all strata. A clear explanation of survey effort and method should also be included. The best practice and standard approach to vegetation mapping is the "Methodology for survey and mapping of regional ecosystems and vegetations in Queensland" by Neldner *et al*., (2005). However, as this approach is not suitable for small sites or identifying some nuances, finer scale mapping techniques should be adopted. Mapping and vegetation descriptions should also consider current status of regrowth, stages of succession evident and status of groundcover, debris and logs.

All native and exotic plant species recorded at the site should be presented as a list of plant species and included as an Appendix to the ERP. The plant species list should include for each species present at the site:

- Scientific name;
- Common name;
- Life form;
- Relative abundance; and
- Conservation value (e.g. status under legislation or significance to koalas) or weed status (if applicable).

The plant species list can be presented in different ways. One common approach is by listing species according to vegetation community.

5.4.8 WEEDS ON THE SITE

Detail should be provided in the ERP on:

- The degree of infestation of declared plants and the class of each declared plant according to the *Land Protection (Pest and Stock Route Management) Act 2002* and/or their status under local ordinances;
- The degree of infestation of highly invasive environmental weeds; and/or
- The abundance of environmental weeds commonly encountered at the site (i.e. major weeds).

Refer to Biosecurity Queensland (part of the Department of Employment, Economic Development and Innovation) or your local government for further information on declared plants and environmental weeds. The information presented may take the form of individual maps, or be described in relation to individual management zones (refer to Section 5.4.14 for detail on management zones).

5.4.9 NATIVE FAUNA

The ERP should be informed by an understanding of the fauna that use the site as habitat (determined through site survey) as well as fauna species present in the greater environment for which site restoration could benefit, in that these species could include the restored site as part of their range. Fauna should be considered in three categories:

- Existing/known presence;
- Likely presence; and
- Potential to occur following ecological restoration.

To establish this information it is likely that the input of a fauna specialist is required. Depending on the nature of the project detailed trapping programs may be necessary to ascertain actual fauna use. Known habitat of scheduled species should be mapped.

Once this information is ascertained, measures that can be undertaken to provide habitat requirements for these fauna should be included in the ERP. These measures may include:

- Maintenance of existing habitat heterogeneity (i.e. the diversity of habitats occurring on site);
- Selection of flora species that provide food resources for fauna (e.g. koala food trees, butterfly host species);
- Selection of flora species that provide cover and habitat for fauna (e.g. dense, small-leaved shrub species for forest birds; reeds for frogs);
- Provision of habitat fixtures into the restoration area (e.g. nest boxes for gliders, hollow logs on ground for reptiles);

- Planting at densities that meet fauna movement / cover requirements (e.g. dense grasses for small mammal movement; using dense lomandra plantings to exclude cane toads from wetland edges); and
- Staged weed control in instances where weeds form a significant portion of fauna habitat or if erosion will become a problem.

It is important to note that weed species in the restoration area may provide valuable habitat and/or food resources for some fauna. For example, small birds such as wren species use thickets of lantana for cover; and uncommon Lewin's Rail (*Rallus pectoralis*), is known to utilise dense areas of rank grassland as core habitat.

Weed control incorporated as part of site restoration therefore has the potential to adversely affect some fauna species. The ERP should aim to manage weed control so that:

- The function of weed species as habitat is identified prior to site works; and
- The removal of weed species is 'tempered' by matching ongoing weed control and restoration with the germination and growth of native plants.

5.4.10 ECOLOGICAL STATUS, SIGNIFICANT SPECIES AND COMMUNITIES – FLORA AND FAUNA

This section should include the following information:

1. An overview of ecological values of the site, including the context of the site within the broader landscape (e.g. does it form part of a significant corridor?);
2. The location and status of threatened and/or significant plants;
3. The location and status of threatened or significant fauna and their habitats; and
4. Any management requirements to ensure the species are maintained on site or to encourage the species back to the site with reference to any relevant management or recovery plans (e.g. management of glossy black-cockatoo will require consideration of the management of sheoak (*Casuarina/Allocasuarina* spp.) and include reference to the Glossy Black-cockatoo Guidelines).

5.4.11 REFERENCE SITES

How the zone was informed by the reference ecosystem should also be discussed and reference site data included in the discussion.

5.4.12 MANAGEMENT ISSUES AND RECOMMENDATIONS

The ERP should identify and describe any issues and threats to biodiversity on or adjacent to the site that are likely to influence management. Examples include:

- Fire protection and maintenance of bushfire asset protection zones;
- Other planning constraints (permits and approvals);
- Potential impacts from adjacent development – e.g. sedimentation, fragmentation;
- Environmental weeds and declared plants;
- Pest animals and domestic pets, including impacts on native species;
- Is the site an active flying fox camp?;
- Livestock grazing;
- Climatic hazards – e.g. frost and flood;
- Unauthorised human access – e.g. motorbike use and tracks;
- Rubbish dumping – e.g. garden waste, household and building waste;
- Site fragmentation and isolation;
- Altered hydrology; and
- Erosion.

The ERP should recommend actions to address each management issue/site threat. For example:

- To manage pest animals and domestic pets, management actions may include community education, enforcement, monitoring and pest animal control;
- To manage browsing by native herbivores (e.g. kangaroos and bandicoots). This may include fencing, tree guards or deterrent spray;
- To manage climatic hazards, management actions may specify timing of planting, use of frost tolerant species in plantings, or the use of species that can tolerate high water flow environments or prolonged inundation in plantings;
- To manage unauthorised human access, management actions may include closing and rehabilitating tracks, signage, fencing and enforcement. This may include education such as signage alerting the public to the restoration project, who's doing it and why;
- To manage rubbish dumping, management actions may include rubbish clean-up, community education, signage, enforcement, restrictions in site access; and
- To manage site fragmentation and isolation, management actions may include establishing or enhancing corridors and connectivity between remnants.

5.4.13 RESTORATION STRATEGY

Restoration strategies may vary across the site, with identification of suitable restoration strategies dependant on the degree of habitat disturbance, the anticipated potential of habitats to recover and the aims and objectives of the ERP. Accepted approaches to site restoration as described in Section 3 are:

- Natural Regeneration;
- Assisted Natural Regeneration;
- Reconstruction; and
- Fabrication (type conversion).

The restoration strategy should determine the goal community or communities across the site. This is of particular importance when a reconstruction or fabrication restoration strategy is chosen, where the aim is to re-establish a Regional Ecosystem similar to the original Regional Ecosystem in structure, composition and diversity.

5.4.14 MANAGEMENT ZONES AND RECOMMENDATIONS

The use of management zones will be necessary where there are spatial or temporal variations in restoration strategies and required management actions across the site. Management zones provide discrete areas in a restoration project that generally require a similar management or treatment response. Identifying zones also assist in the staging and resourcing of works on larger restoration projects.

Specific implementation strategies should be listed for each management zone, detailing the step-by-step approach, methods and techniques to be used in each case. For each zone, the objectives should remain reflective of the overall ERP Aim/s.

Where assisted natural regeneration (e.g. fencing to exclude livestock plus weed control to encourage natural regeneration) is proposed in a management zone, detailed methods and techniques for assisted regeneration need to be specified, including:

- Location and type of fencing;
- Primary weed control methods for woody, vine, forb, grass and aquatic weeds;
- Timing of weed control; and
- Follow up weed control requirements including methods, timing and frequency.

For example, where planting (i.e. reconstruction) is proposed in a management zone, detailed methods and techniques for planting should be specified, including:

- Fencing (if necessary);
- Sourcing of planting stock;
- Preparation of planting site including sequence of weed control;
- Timing of planting;
- A list of suitable local native species to be used in the planting (may be included as an Appendix to the ERP);
- Number of each species;
- Planting density;
- Use of mulch and fertiliser;
- Ongoing maintenance requirements. Maintenance requirements should be customised for each project and include, where relevant, a break down into:
    - Watering;
    - Fertilising;
    - Weeding;
    - Plant replacement;
    - Fire frequency, timeframes;
    - Contingency; and
- Align with monitoring and reporting; and
- Weed hygiene for vehicles and tools.

The success of most projects rest in project maintenance. A schedule of maintenance actions aligned with timeframes and/or triggers is required. The maintenance program must respond to the process of adaptive management (discussed in Section 5.4.17). By clearly articulating maintenance requirements, this vitally important component of ecological restoration can be adequately costed into projects. Maintenance utilises many of the techniques applied in initial project implementation. The Manual component of the Ecological Restoration Framework describes basic maintenance approaches applicable to every project.

When planting is proposed, species selection, abundance and placement should be consistent with the vegetation community being restored. Seed collection and propagation should be consistent with the principles of genetic integrity.

Specific actions for management zones may also include, for example, measures to minimise impacts to flora and fauna during restoration works, including:

- Changing weed control methods or herbicide use when controlling exotic grasses amongst native grasses and forbs, when controlling weeds adjacent to a threatened plant species and when controlling weeds in aquatic habitat and/or habitat of frog species. Various techniques can be used for the one species, for example, lantana may be controlled using a combination of handpull and Cut-Scrape-Paint (CSP) when it is mixed in with native species, spot-sprayed when conducting follow up or a combination of overspray, splatter gun or cut and spray the regrowth when dealing with more extensive infestations;
- Timing on ground work in the vicinity of significant fauna habitat (raptor nests, flying fox camps) to avoid disturbance to breeding;
- Minimise ground disturbance (i.e. trampling) in sensitive habitats;
- Specifying hygiene protocols where there is a risk of transmission of disease. For example spread of Chytrid fungus to all frog habitats or spread of phytophthora (*Phytophthora cinnamomi*) and myrtle rust (*Uredo rangelii*) to susceptible plant communities; and
- Using fauna friendly fencing.

5.4.15 IMPLEMENTATION

This section should include:

- An Implementation Schedule detailing actions to be undertaken across the whole of site and within each management zone to achieve the aims and objectives of the ERP. The Implementation Schedule should prioritise management actions and specify timing for the implementation of each management action for the duration of the ERP. The Schedule may also include resource requirements (including labour) for each management action. This information may be presented in a table. All maintenance and monitoring requirements should be included;
- Information on the qualifications of personnel involved in the implementation of the ERP (i.e. on ground weed control works, monitoring and reporting);
- Any permits or licences required to implement the ERP;
- A workplace health and safety plan/risk assessment; and
- Record keeping requirements to comply with legislative requirements.

5.4.16 MONITORING

The monitoring strategy should set out the intended monitoring methodology and Performance Indicators and must specifically address the management aims and objectives of the ERP. The monitoring strategy should set out timing of monitoring (baseline and ongoing), monitoring frequency and specify the qualifications of the personnel undertaking the monitoring. This should be presented in a tabular format similar to the examples presented in Appendix A.

Monitoring is not an optional component to the ERP. It is imperative to demonstrate how Performance Indicators are achieved and to this end must be based on the Performance Indicators. The level of monitoring input however may vary between projects depending on their individual complexity and purpose of the project. For example, a project restoring the habitat of a scheduled bird species may require rigorous fauna studies to demonstrate the project's objectives are met. In other instances, photo monitoring points may suffice. Monitoring methodologies are discussed in the Ecological Restoration Manual.

5.4.17 ADAPTIVE MANAGEMENT AND CONTINGENCY PLANNING

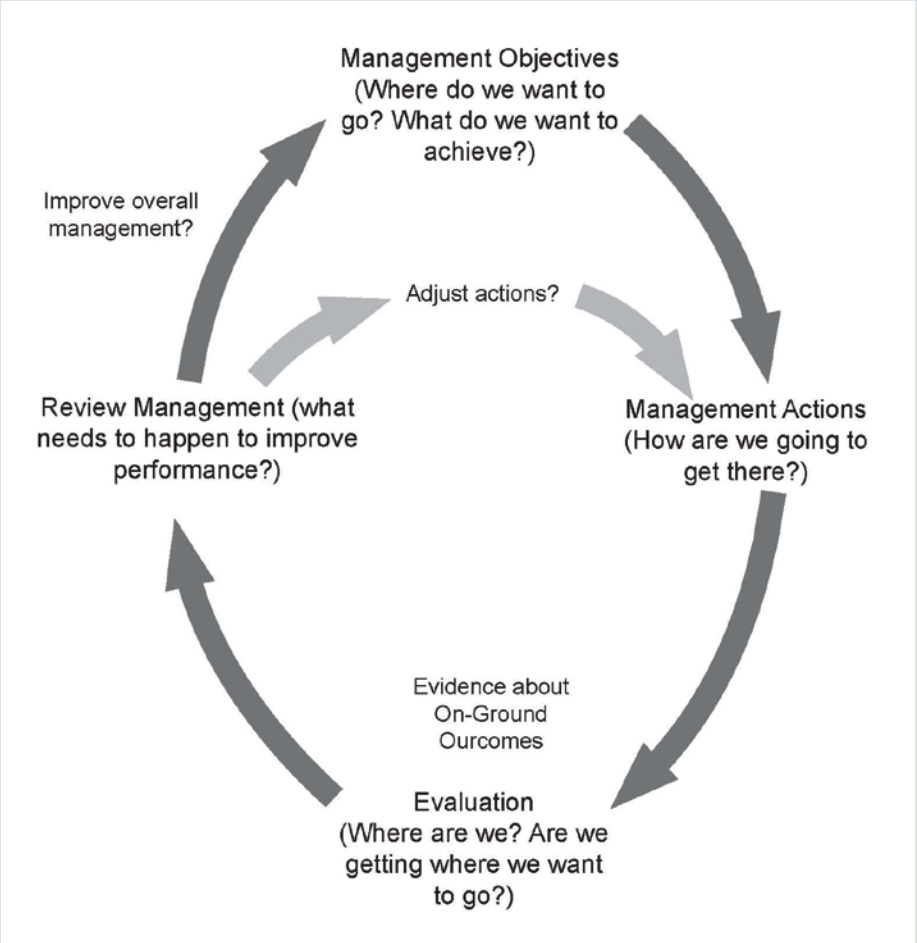
A key factor for the success of a project will be the ability of those implementing the ERP to respond to changing site conditions. The purpose of regular monitoring, recording and reporting is not just to document the progress of the project, but also to provide feedback to the managers on the success or failure of the various management strategies and allow adaptation of the restoration techniques and implementation schedule to achieve maximum effectiveness.

This approach is in accordance with the process of 'adaptive management'. Adaptive management can be broadly defined as a flexible management approach that allows for improved management responses by either adopting, or amending, management actions throughout the duration of the project. The approach requires a clear understanding of the overall management objective (so that one can define what a successful outcome would be), implementing management actions, evaluating their performance in meeting the objective, and amending or retaining management actions accordingly (AEDA, April 2008). This process is diagrammatically illustrated over page in Figure 6.

In doing this, managers learn from their mistakes and are not committed to a management process that will not succeed. Adaptive management is therefore a useful means of managing systems that are not completely understood (AEDA, April 2008).

Provision should be made in the ERP for adjusting the proposed management strategies in response to unanticipated circumstances (e.g. fire, drought, floods, planting failure, vandalism and insect pests), technical advances and/or regular monitoring.

Figure 6 - Adaptive Management Approach



5.4.18 REPORTING

Reporting on the progress of the ERP may be required to demonstrate that the restoration project is achieving its aims and objectives. The ERP should specify the reporting requirements including:

- Frequency of reporting;
- Duration of reporting; and
- Who the report will be submitted to.

Progress reports should include:

- Progress on implementation of the Implementation Schedule;
- Monitoring results and compliance with Performance Indicators;
- Any changes in the Implementation Schedule as a result of adaptive management;
- Progress of ongoing site management issues;
- Any records of threatened flora and fauna species; and
- Recommendations regarding the ongoing management of the site.

There may be additional reporting requirements if a project is undertaken with funding attained through a grant or as a condition of approval from a government agency.

Even if reporting is not a project requirement, documenting progress is a useful means of keeping track of a project and measuring progress and success. A generic daily record sheet is provided in the Manual.

5.4.19 REFERENCES

List all reference material used in the preparation of the ERP.

5.4.20 APPENDICES

Typical appendices to an ERP include, but are not limited to:

- Flora species lists – native and weed species;
- Fauna species lists, if available and/or relevant;
- Any detailed assessments of reference ecosystems;
- Weed control methods;
- Specific rates of control for weeds;
- Planting list (if required);
- Photo point locations, photos and captions;
- Initial monitoring points and baseline data;
- Daily Record Sheets including Chemical Use; and
- Job Safety Analysis/Risk Assessment.

6 PROJECT DELIVERY

"In most instances at least 2-5 years are required to ensure the success of a project."

6.1 CHOOSING A RESTORATION PRACTITIONER

It is important to ensure that the restoration practitioner selected has the necessary qualifications and experience to carry out the work proficiently. Relevant qualifications may include a certificate in Conservation Land Management - Natural Area Restoration from a TAFE college or a university degree in a related field such as ecology or vegetation management. It is advantageous to select a practitioner who is experienced in the particular vegetation type that is to be restored e.g. wetland or rainforest. It must be mandatory that the practitioner has had 'hands-on' experience. Practitioners must hold applicable licences such as:

- Commercial operator's licence (ground application of herbicide) issued under the *Agricultural Chemicals Distribution Control Act 1966*;
- Senior First Aid Certificate;
- White Card i.e. General Safety Induction (Construction Industry) if working on a construction site; and
- Relevant Ecoaccess permits are required to cultivate, propagate or use protected plants, issued by the Department of Environment and Resource Management (DERM).

Practitioners should have extensive and relevant experience including the basic need to have good plant identification skills and techniques used in the restoration industry. A knowledge of local flora and weed species and their control is a fundamental requirement. This is necessary so that natural regeneration on any restoration project is retained during management of weeds.

It is essential that the responsibilities of the practitioner are clearly defined and that open lines of communication are maintained between the practitioner and those ultimately accountable for the project.

6.2 WHEN IS A PROJECT COMPLETE?

The endpoint of the actively managed phase of a project is not easily identified in advance. It is necessary to evaluate monitoring results to determine the amount of follow-up work that will be required. Often, where there are high levels of pre-existing degradation or the presence of extremely invasive weed species, maintenance of the site must continue for many years. For example, the presence of an infestation of madeira vine (*Anredera cordifolia*) requires a commitment of five to ten years of consistent follow-up weed control.

Regular inspections of the site to ascertain progress and determine the need for follow-up are also essential, particularly in the first year or two following primary restoration works. Maintaining a close interest in the site ensures that adaptive management techniques can be practised and that any contingencies can be planned for.

As mentioned in Section 2.1, the goal of ecological restoration is to create or re-establish an ecosystem which is ultimately self-sustaining. However, in many cases this will not be entirely possible. The continual reintroduction of weed propagules to the site from nearby residential areas, global influences such as climate variation, and changes to hydrology are all examples of ways in which a site may be

exposed to ongoing disturbances. In these circumstances, the project may never be considered to be "completed", thus necessitating a degree of maintenance on an indefinite basis. This should not, however, be considered a reason for delaying or avoiding ecological restoration work. Sites that have been identified as being of value to society will almost inevitably require that ongoing efforts be made in order to preserve the desired attributes, such as biological diversity or ecosystem services.

Two key milestones underpin when a project is complete:

- Have the Performance Indicators been met?; and
- Most projects require 2-5 years of implementation and maintenance.

An important facet of project completion is to share an account of the project, including both successes and failures. This may take the form of a written article published in a relevant journal or newsletter, or an oral presentation at a conference or field day. This is a way of ensuring continued interest in a site, as well as fulfilling public accountability requirements, but it is also a method that enables other people to learn from your experiences. Ecological restoration techniques can be greatly improved through the sharing of case studies and the pooling of knowledge, in what is still a new and developing field of endeavour, with many lessons to be learnt.

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GLOSSARY

Abiotic: Non biological influences such as light, wind, modified hydrological regimes and changed soil conditions.

Biodiversity: The variety of life and its processes, including diversity of organisms, genetic diversity, and the communities and ecosystems in which they occur.

Biotic: Biological influences such as pests (weeds and animals) and 'rogue' native plant species.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. (compare with *Rehabilitation*)

Ecologically Sustainable Development (ESD): Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The targets of the South East Queensland Natural Resource Management Plan 2009–2031 represent the outcomes of ESD.

Ecosystem: Consists of the biota (plants, animals, microorganisms) within a given area, the environment that sustains it, and their interactions.

Ecosystem services: The goods and services provided by ecosystems that benefit, sustain and support the wellbeing of people. They include production of food and medicines, regulation of climate and disease, provision of productive soils, clean water and air, opportunities for recreation and spiritual benefits. (from South East Queensland Regional Plan).

Environmental weeds: All weeds impacting the environment including those lised under the *Land Protection (and Stock Route Management) Act 2002* and local council ordinances.

Function: The dynamic attributes of an ecosystem, including interactions among organisms and interactions between organisms and their environment.

Indigenous species: The biota that occur in a particular location such as in a reference ecosystem (see also *Local provenance*).

Local provenance: Indigenous species established from the seed sourced from natural populations within a particular site or area (see also *Indigenous species*).

Performance Indicators: Provide very clear goals and are used to establish if the aims and objectives of the ecological restoration plan are being met.

Precautionary principle: Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Reference ecosystem (or reference community): An ecosystem that serves as the model for planning an ecological restoration project and as a reference against which the success of the project can be evaluated. The reference ecosystem has not been subject to extensive past disturbance.

Regional Ecosystems (REs): Communities of vegetation that are consistently associated with a particular combination of geology, land form and soil in a bioregion. The Queensland Herbarium has mapped the remnant extent of regional ecosystems for much of the state using a combination of satellite imagery, aerial photography and on-ground studies.

Rehabilitation: Emphasises the reparation of ecosystem processes, productivity and services, without necessarily re-establishing the pre-existing biotic integrity.

Resilience: The ability of an ecosystem to regain structural and functional attributes that have suffered harm from stress or disturbance.

Self-sustaining: A restored ecosystem which is resilient to disturbance and requires minimal long-term management input.

Structure: All vegetative elements within an ecosystem either dead or alive including, but not limited to, trees, shrubs, ground covers, lianes, logs and leaf litter.

Threatened species: Plants or animals which have been listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, rare or conservation dependant under either Federal or State legislation.

Vegetation community: An assemblage of particular populations of different plant species within a specified location in space and time.

ACRONYMS

AABR: Australian Association of Bush Regenerators

BOO: Best on Offer

CPTED: Crime Prevention Through Environmental Design

CSP: Cut-Scrape-Paint

DERM: The Department of Environment and Resource Management

EAP: Ecological Assessment Reports

EIANZ: Environment Institute of Australia and New Zealand

EMTRG: Environmental Managers Technical Reference Group

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*

ERP: Ecological Restoration Plan

SEQ: South East Queensland

SERI: Society for Ecological Restoration International

SMART: Specific, Measurable, Achievable, Realistic, Timed

APPENDIX **A**

EXAMPLES OF PROJECT OBJECTIVES AND PERFORMANCE INDICATORS

EXAMPLE FOR A COASTAL DUNE HABITAT

Goals: To restore Coastal Dune Habitat

OBJECTIVES (EXAMPLES)	PERFORMANCE INDICATORS (EXAMPLES)
The site supports plant species capable of sustaining a reproducing population	• High (>70%) survival rate of planted stock and naturally recruited native species. • A density of trees to average 1 per $5m^2$ over the whole dunal area at the end of the fifth year of the Plan. • Colonisation and use of the site by native flora and fauna. • No inappropriate genetic material used in plantings. • Growth of tree species to achieve an average height of >1metre by the end of the fifth year of the Plan.
The site is stable and not subject to erosion	• Frontal and secondary dune vegetation maintained in good condition. • Complete prevention of blowouts. • Effective restriction of access by pedestrians, vehicles and domestic and feral animals to the revegetation sites
Exotic species do not affect native plant species recruitment and survival	• Sustained reduction of weed species to a level that ensures natural recruitment by native species is not suppressed or excluded. • Nil fruiting of weed species after primary treatment.

EXAMPLE FOR A COASTAL RIPARIAN HABITAT

Goals: To restore Coastal Riparian Habitat

OBJECTIVES (EXAMPLES)	PERFORMANCE INDICATORS (EXAMPLES)
The site supports plant species capable of sustaining a reproducing population	• Increased number and abundance of native species. • Increased recruitment of native species. • Increased percentage canopy of native species. • No inappropriate genetic material used in plantings. • >70% survival rate of planted stock and naturally recruited native species. • Growth of >1 metre by year three and 1.5 metres by year five for rainforest plantings and cover (cumulative cover from ground level to canopy) of 60% after 3 years and 80% after five years for sclerophyll plantings. • Increased colonisation and use of the site by native fauna.
The site is stable and not subject to erosion	• Effective restriction of access by pedestrians, vehicles and domestic and feral animals to the revegetation sites. • No net increase in streambank erosion.
Exotic species do not affect native plant species recruitment and survival	• Primary treatment of all weeds in the riparian zone by the end of year three. • Nil fruiting of weed species after primary treatment.