

Lake Macquarie

Development Control Guidelines

Preparation of Rehabilitation Plans
for Degraded Watercourses or Water Bodies



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1 INTRODUCTION

These guidelines are designed to help landowners prepare rehabilitation plans for degraded watercourses or water bodies. The Guidelines are a support document to Council's Local Environmental Plan 2014 (LEP) and Development Control Plan 2014 (DCP).

Every place in our city is part of a catchment that drains to a stream or wetland, and then to either Lake Macquarie or the ocean. A catchment area of approximately 680km² drains to Lake Macquarie via a network of 2424km of streams (or watercourses), varying in size from large creeks such as Cockle Creek, Winding Creek and Dora Creek, to small roadside drains. Dora Creek drains a relatively natural landscape from the Watagan Mountains and Martinsville, while Winding Creek drains the urbanised area of Charlestown, Cardiff and Glendale. The catchment area of Cockle Creek is progressively becoming more urbanised through residential development in Edgeworth and Cameron Park.

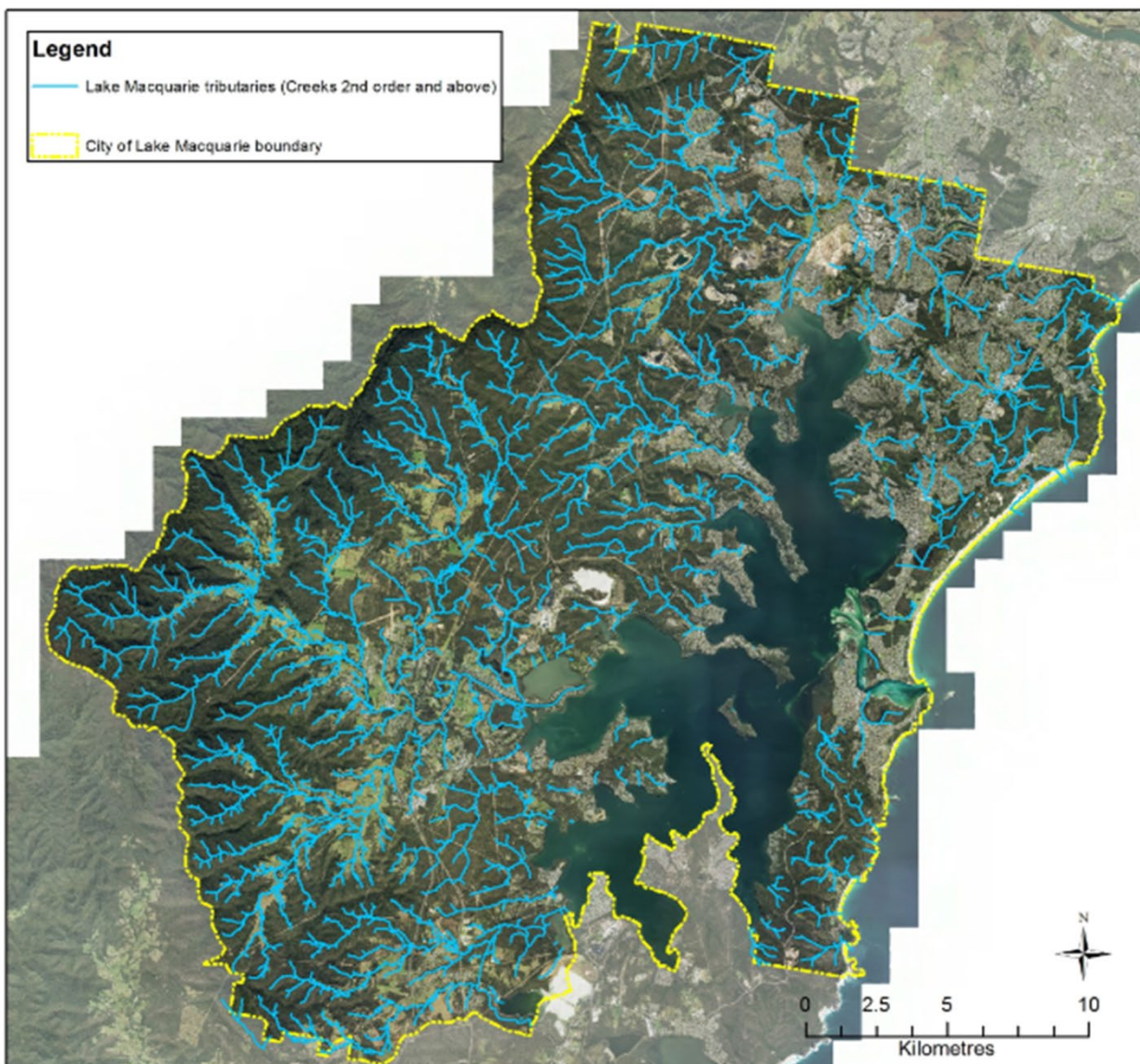


Figure 1 - Lake Macquarie Tributaries

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An important part of all watercourses is the area of land adjacent to the waterway, which is known as the riparian corridor. Native vegetation along watercourses (including stream banks) is vital to maintaining these areas in good condition. Streams, their riparian zones and wetlands, play an important role in our environment including:

providing habitat for plants and animals, including a number of rare or endangered species;

With the assistance of a group of experts, Murray (2014) identified 57 fauna species of concern in Lake Macquarie Local Government Area (LGA). These are species that it is important to consider in future planning of the City. Analysis of the habitat requirements of these species (Murray 2014) identified that 24 out of them, require access to surface water as part of their habitat including creeks/streams, drainage lines, riparian areas and floodplains. As a separate exercise, mapping of the habitat for 53 threatened species (i.e. listed in Biodiversity Conservation Act 2016) also highlighted riparian areas as supporting habitat for the greatest range of threatened species.

providing native vegetation corridors for movement of plant pollinators, seed and fauna between suitable habitat (both aquatic and terrestrial);
reducing pollutant loads by helping filter litter, sediment and excess nutrients from stormwater runoff, helping to maintain the quality of our lake and beaches;
reducing flooding, damaging erosion and sedimentation;
shading watercourses, which controls water temperature and prevents excess growth of water plants;
providing vital breeding habitat and nursery areas for fish and other aquatic species;
offering a natural landscape for all to enjoy for relaxation or recreation; and
providing an interface or buffer between development and waterways.

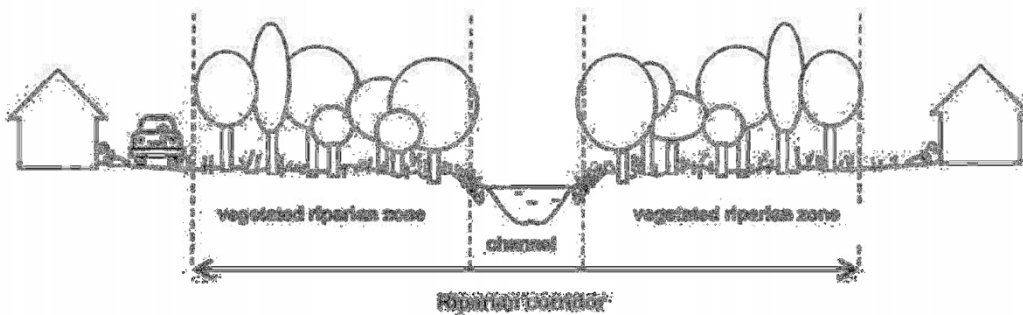


Figure 2 - Riparian corridor (Source: Guidelines for Riparian Corridors on Waterfront Land, DPI Water, 2012)

In the past, development of the urban landscape has not allowed for adequate infiltration of rainwater. Bushland, grassy paddocks and streams, where rainwater once soaked into the ground, have been replaced by hard surfaces such as roofs, paving, roads and concrete pipes and drains. As the developed area of the catchment increases, so does the quantity of stormwater and the amount of pollutants flowing into surrounding watercourses and drainage channels.

Development of a catchment can result in four to six times as much runoff compared to predevelopment levels. As a result, watercourses adjust to the increased quantity and velocity of water, leading to erosion of the banks and bed. In smaller, more frequent events (where most rainfall would normally soak into the ground), runoff in developed areas can increase up to 40 times the predevelopment volume.

In many areas, the riparian vegetation has been removed or is in such a degraded state that it cannot perform its environmental role. Degraded watercourses can suffer from:

erosion and sedimentation of the watercourses and in Lake Macquarie;
reduction in habitat for plants and animals, which can result in loss of biodiversity;

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reduced water quality, as the capacity to filter nutrients and sediments is reduced. This can lead to problems such as algal blooms, turbid or muddy water, and reduced recreational amenity; erosion and weed invasion; and destruction of seagrass beds due to muddy water blocking out the light.

It is possible to improve the condition of watercourses through appropriate rehabilitation. Where successful, rehabilitation can lead to not only improved ecology and water quality, but can enhance the amenity and aesthetics to produce desirable development outcomes.

2 WHAT IS A REHABILITATION PLAN?

A Rehabilitation Plan details how the rehabilitation of the subject watercourse or water body will be carried out. Where the length of the watercourse located on site is greater than 50 metres, the rehabilitation plan must be prepared by a suitably qualified consultant.

3 WHEN IS A REHABILITATION PLAN REQUIRED?

One of the objectives within Council's DCP is to ensure that natural water systems* and their associated riparian vegetation and landforms are protected to improve the ecological processes and ensure land is adequately buffered from development.

Controls within Council's DCP require the rehabilitation of a natural water system under the following circumstances:

where a development is associated with or will affect a natural water system, rehabilitation must occur to return that natural water system, as much as possible, to a natural state;
where a development site includes a degraded watercourse** or water body.

More specifically, a Rehabilitation Plan is required for development sites that contain a natural water system in the following circumstances:

subdivisions > 3 lots: or
developments that encroach within the vegetated riparian zone as specified in Figure 1 and Table 1 of Section 2.10 Natural Water Systems in Council's DCP 2014; or
in response to a court order or Council direction following unauthorised clearing or works: or
where the development site has been identified as having a degraded watercourse**.

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Watercourse type	VRZ width (each side of watercourse)	Total RC width
1 st order	10 metres	20 m + channel width
2 nd order	20 metres	40 m + channel width
3 rd order	30 metres	60 m + channel width
4 th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

Table 1: Recommended riparian corridors (RC) widths (Source: Guidelines for Riparian Corridors on Waterfront Land, DPI Water, 2012)

A Rehabilitation Plan is required to assist in the planning of the rehabilitation works and as a means of demonstrating to Council the applicant's intent to carry out the works. The completed plan is to be submitted to Council for approval, prior to issue of the first construction certificate.

***natural water systems** – is a naturally occurring watercourse, waterway, lake, wetland, lagoon, estuary, and/or other waterbody.

****degraded watercourse** – include watercourse with riparian corridor devoid of native vegetation; watercourse that has previously been modified, re-directed or re-aligned; watercourse suffering from erosion or other geomorphic changes; watercourse with riparian corridor infested with weeds.

4 STRUCTURE AND FORMAT OF A REHABILITATION PLAN

The purpose of a Rehabilitation Plan is to outline the desired outcomes and to specify works and actions to be carried out to achieve these outcomes. It must clearly state quantifiable objectives that are to be achieved and should be suitable for both the landowner, approval authorities and the persons who are required to undertake implementation actions.

It will usually include maps, photos and supporting texts and relevant background information. The required structure for the rehabilitation plan is shown in Table 1, together with an explanation of information to be included in each section. A downloadable template for a rehabilitation plan is available in Appendix 1. The plan structure may vary where appropriate.

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Table 2 - Required Rehabilitation Plan Structure

Section	Explanation
1. Introduction	
Name of plan and location	The plan must be clearly described and dated, and must show the land to which it applies, including a plan, street address, and property identifier (Lot & DP).
Land ownership	Provide details of current and future ownership arrangements, as well as ownership details of adjacent landowners (public or private).
Scope	Outline the justification for the preparation of the plan. Some plans may be the result of a legal agreement (e.g. Condition of Consent for development).
Definitions	Clear definitions are essential for the proper interpretation of the plan.
2. Background Information	
Planning and landscape context	Current and proposed land-use and the landscape. Context of the land to which the plan applies.
Natural values	A summary of the ecology, geomorphology, hydrology and, flooding characteristics of the site. See section 7.1.
Other site values	There may be important community values and issues that need to be identified, such as, Aboriginal cultural sites, heritage values, public access, walking tracks, utilities or public health and safety issues. See section 7.1.
Relationship with other plans, approvals or legislation	Identification of other approvals that may be required to carry out the rehabilitation works (e.g. Controlled Activity Approvals Under the <i>Water Management Act 2000</i> , Fisheries Permit under <i>Fisheries Management Act 1994</i>). See section 6.
3. Objectives and Strategies	
Rehabilitation objectives	Clear objectives should underpin a rehabilitation plan. The objectives should reflect the rehabilitation issues and be measurable to allow future monitoring. Please use the <i>National Standards for the Practice of Ecological Restoration in Australia, (Society for Ecological Restoration Australasia, 2016)</i> as a guide.
Rehabilitation strategies and priorities	Strategies and statements outlining how the objectives will be carried into effect. Strategies and priorities should be based on proper analysis of the site values and ecological process, as reflected in the plan objectives. They should reflect the priorities of the site.
4. Rehabilitation Program	
Rehabilitation issues	Issues to be addressed in the rehabilitation plan are to be outlined in detail including a description of the issue and

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	proposed actions to manage the issue. See sections 7.2-7.4.
Implementation	<p>For each work and task (action), the plan must:</p> <ul style="list-style-type: none"> Describe the proposed work. For example, revegetation of the riparian area with native species; Identify those responsible for completing the required works, and the required minimum qualification for persons undertaking the work, task or action; Include a schedule of works to identify project milestones and completion dates (e.g. details of planting program) and best times of the year to plant); Include a detailed map showing the location and type of rehabilitation activities; Outline the budget for the works; and Outline risks and contingency measures (e.g. flood events).
Approvals and consultation	<p>Approvals required prior to commencement of work. See section 6.</p> <p>Consultation with relevant authorities (e.g. Department of Primary Industries (DPI) Water, DPI Fisheries, Council) may be useful to guide development of the works program.</p>
Monitoring	<p>Actions for monitoring the works program are essential to measure the success of the rehabilitation program. See section 7.5.</p>
Maintenance	<p>The development of a maintenance program for the rehabilitation site is essential. See section 7.6.</p>
5. References	
Resources and references	<p>The plan must identify sources of information and relevant references justifying the proposed actions.</p>
6. Maps	
Vegetation maps	<p>Should show vegetation communities and may identify key management issues (e.g. areas of weeds or disturbance)</p>
Monitoring locations	<p>Location of monitoring sites must be defined.</p>
Site analysis	<p>Should show all the physical (natural and man-made) characteristics of the site. See section 7.1</p>
Rehabilitation map	<p>Should include a map showing the location and type of rehabilitation works proposed. Include cross-sectional diagrams, where possible, for in-stream works.</p>

5 PERSONNEL TO PREPARE AND IMPLEMENT THE REHABILITATION PLAN

Expert advice will help in selecting the appropriate methods for undertaking the necessary works. The local office of Natural Resources Access Regulator (NRAR), or a private environmental consultant, will be able to assist with advice on rehabilitation techniques. Environmental consultants with expertise in the areas of ecology, geomorphology or environmental engineering should be considered.

Properly preparing and managing contracts is essential to achieving good on-ground rehabilitation outcomes. The preparation of a rehabilitation plan and the undertaking of works can be combined or undertaken separately. However, where possible they should be done in conjunction with one another.

The scope of bush regeneration contracts and issues to be taken into consideration are outlined in *Bush Regeneration: A Practical Guide to Contract Management* (Davies and Dixon 2013), for those projects including bush regeneration activities.

When engaging a contractor, preparing a project brief or contract consider the following matters:

1. Are the persons suitably qualified, and do they have the appropriate experience relevant to the local area?
2. What are the requirements for project management (eg meetings and consultation)?
3. Are the project deliverables and timeframes clearly understood?
4. Is there a requirement for neighbour or community consultation to be undertaken?
5. Have issues relating to public liability, workers compensation and other insurance been considered?
6. Has all relevant information been provided to the contractor?

6 OTHER DOCUMENTATION REQUIRED

All statutory and other planning controls that apply to the proposed works must be adhered to, including but not limited to the following:

6.1 DEVELOPMENT APPLICATION (DA)

Under the provisions of Council's LEP, any environmental protection works* on private property requires Council approval. To obtain this approval development consent is required through the lodgement of a Development Application (DA).

***environmental protection works** means works associated with the rehabilitation of land towards its natural state or any work to protect land from environmental degradation, and includes bush regeneration works, wetland protection works, erosion protection works, dune restoration works and the like, but does not include coastal protection works.

6.2 CONTROLLED ACTIVITY APPROVAL

Under the *Water Management Act 2000*, a Controlled Activity Approval is required from NRAR for any controlled activity that is carried out on waterfront land.

Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 meters of the highest bank of the river, lake or estuary.

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Under the *Water Management Act 2000*, a river, lake and estuary are defined as the following:

"river" includes:

- (a) any watercourse, whether perennial or intermittent and whether comprising a natural channel or a natural channel artificially improved;
- (b) any tributary, branch or other watercourse into or from which a watercourse referred to in paragraph (a) flows; and
- (c) anything declared by the regulations to be a river, whether or not it also forms part of a lake or estuary, but does not include anything declared by the regulations not to be a river.

"lake" includes:

- (a) a wetland, a lagoon, a saltmarsh and any collection of still water, whether perennial or intermittent and whether natural or artificial; and
- (b) any water declared by the regulations to be a lake, whether or not it also forms part of a river or estuary, but does not include any water declared by the regulations not to be a lake.

"estuary" means:

- (a) any part of a river whose level is periodically or intermittently affected by coastal tides;
- (b) any lake or other partially enclosed body of water that is periodically or intermittently open to the sea; or
- (c) anything declared by the regulations to be an estuary, but does not include anything declared by the regulations not to be an estuary.

Under the *Water Management Act 2000*, a Controlled Activity means:

- a. the erection of a building or the carrying out of work (within the meaning of the *Environmental Planning and Assessment Act 1979*);
- b. the removal of material (whether or no extractive material) or vegetation from land, whether by way of excavation or otherwise;
- c. the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise; or
- d. the carrying out of any other activity that affects the quantity or flow of water in a water source.

Some examples of the type of works that would require a controlled activity approval include: modifications or enhancements to a watercourse, channel realignment, bed control structures and stream bank stabilisation. For a full list of works and activities that can occur on waterfront land and in riparian corridors, subject to a controlled activity approval from NRAR, see Table 2 contained within NRAR Guidelines for controlled activities on waterfront land.

Refer to the NSW Department of Industry website for information on controlled activity exemptions on waterfront land - www.water.nsw.gov.au

It is the intent of these Guidelines that the Rehabilitation Plan can be submitted with the Controlled Activity Application to NRAR to streamline the development assessment process, ultimately decreasing the time it takes NRAR to make a determination, saving applicants time and money.

6.3 NSW DPI APPROVALS

Development approvals

NSW DPI administers the *Fisheries Management Act 1994*. Under Sec 4.16 of the *Environmental Planning and Assessment Act 1979*, NSW DPI is a 'Determining Authority' for local development that required one or more of the following permits under the *Fisheries Management Act*:

Section 144 - aquaculture permit (i.e. cultivating fish or marine vegetation for sale/commercial purposes);

Section 201 - permit to carry out works of dredging or reclamation (i.e. any excavation within, or filling or draining of, water land or the removal of woody debris, snags, rocks or freshwater native aquatic vegetation or the removal of any other material from water land that disturbs, moves or harms these in-stream habitats);

Section 205 - permit to harm (cut, remove, injure, destroy, shade etc) marine vegetation (saltmarshes, mangroves, seagrass and seaweeds); and/or

Section 219 – permit to obstruct the free passage of fish.

Any development that requires consent from local government and one or more of the above approvals is deemed to be 'integrated development' under Sec 4.46 of the *Environmental Planning and Assessment Act 1979*.

Some examples of integrated development that are relevant to these guidelines that may require one of the permits listed above include:

channelisation, relocation or realignment of waterways;
stream bed or bank stabilisation works (involving dredging, earthworks or reclamation to halt erosion);
bridges, culverts, causeways (both piped and un piped) or other road-crossings of waterways (temporary or permanent) which requires placing material on the bed of the waterway (i.e. reclamation) and/or which may obstruct the free passage of fish;
boat ramps and boat sheds (i.e. reclamation);
dams, weirs, floodgates or levee banks across waterways (i.e. obstruction of fish passage);
installation of pipelines across a waterway (involving dredging or reclamation);
installation of stormwater outlets (involving reclamation of the bed or bank of a waterway);
boardwalks or walking tracks that cross intertidal areas, coastal wetlands, seaweeds or seagrasses;
and
development that may affect marine vegetation by cutting, removing, destroying, transplanting, shading or damaging it in any way (g. trimming mangroves).

Conservation of key fish habitats

One of the key objectives of the *Fisheries Management Act 1994* is to conserve 'key fish habitats'. 'Key fish habitats' are not defined within the *Fisheries Management Act*. The document *Policy and Guidelines for Fish Habitat Conservation and Management*, prepared by NSW DPI (2013), outlines the approach adopted by NSW DPI to define these habitats to ensure effort and resources are focused on those most important for fish conservation. Please refer to this document for more detailed policy and guideline statements with respect to activities, developments, and impacts on key fish habitats.

It is worth noting however, that for the purposes of these key fish habitat policies and guidelines, the following are **not** considered key fish habitat:

first and second order streams on gaining streams (based on the Strahler method of stream ordering);
farm dams on first and second order streams or unmapped gullies;
agricultural and urban drains;
urban or other artificial ponds (e.g. evaporation basins, aquaculture ponds);
sections of stream that have been concrete-lined or piped (not including a waterway crossing); and
canal estates.

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However, if any of these are found to be habitat of a listed threatened species, population or ecological community or 'critical habitat', then they would be considered 'key fish habitat'.

For further clarification on key fish habitats contact the local office of NSW DPI Fisheries Office.

7 INFORMATION YOU SHOULD INCLUDE IN A REHABILITATION PLAN

7.1 SITE ANALYSIS

This section should provide a detailed overview of all the physical (natural and man-made) characteristics of the subject site.

Objectives

To show the location of all the physical characteristics of the site in proximity to any watercourses located on the subject site.

Relevance of this section

A site analysis plan forms the basis for good site planning.

Detail required

The site analysis should include a surveyed plan of the site showing the following:

- slope of the site – contours;
- land boundaries
- location of any existing watercourse/s (including top and bottom of banks and centreline of watercourse), wetlands or drainage lines;
- any existing and proposed developments for the site;
- infrastructure (e.g. roads, sewer, stormwater or power lines);
- distances shown between top of streambank to buildings and/or developments;
- Asset Protection Zones (APZ);
- vegetation (community type, hazardous weeds or environmental weeds);
- easements, covenants and/or restrictions;
- soil type – erodibility;
- rock outcrops or other landform features;
- management zones;
- condition of the watercourse (e.g. erosion, sediment build up or head cuts);
- any Aboriginal sites and areas of high archaeological potential for indigenous heritage (AHIMS search);
- any listed heritage items, heritage conservation areas and areas of high archaeological potential for non-indigenous heritage (see Lake Macquarie LEP 2014 Schedule 5); and
- any relics or objects related to the settlement of New South Wales.

7.2 HYDROLOGY AND EARTHWORKS

This section refers to works that will affect the flow and chemistry of water, and the form of the watercourse bed and banks or wetland bed.

Objectives

- To return soil levels and surface and groundwater flow and chemistry to stable conditions.
- To stabilise the bed and banks of degraded watercourses.
- To obtain an understanding of stream processes to enable the treatment of causes rather than symptoms.

Relevance of this section

Hydrology and earthworks will need to be considered where the following is evident:

- erosion of streambed and/or banks;
- areas of land that have been filled (e.g. areas where the soil level adjacent to waterway has been raised);
- unauthorised streambank/bed stabilisation works;
- pipng, filling or redirecting of a natural water system; or
- other works affecting the flow of water.

Soft engineering approaches that protect or enhance the natural state of the streambank are preferred by Council. Heavily engineered systems may be required, where exceptional circumstances have resulted in active erosion. These treatments are typically used as a last resort.

Generally, 'soft' treatments include the rehabilitation or re-establishment of native vegetation to stabilise streambank material.

'Hard' treatments include the use of rock gabions, rock riprap, or concrete to retain and armour the streambank or structures that impede the flow of water, such as weirs.

Rehabilitation plans involving 'hard' treatments' within the bed or banks of a watercourse are required to be prepared by a suitably qualified professional, with expertise in environmental engineering or geomorphology.

Detail required

The information in this section should include the following:

- a detailed site map showing location of all earthworks to be undertaken;
- depth to which soil is to be removed;
- a list of works in chronological order. Completion dates for each task should be in the shortest timeframe possible, without compromising environmental safeguards;
- methods used to avoid disturbance of acid sulfate soils;
- methods for the management of acid sulfate soils;
- methods for earth moving and for temporary storage, transport and disposal of materials;
- methods for erosion and sediment control prior to, during and after the rehabilitation works have been completed (please refer to 'White Books' – IECA 2008 for detailed information on erosion and sediment control);
- site monitoring and feedback on site management;
- contingency planning for system failure or natural events (flood, storms) including monitoring maintenance of water quality;
- detailed design drawings for any stabilisation or structural works (engineering certification maybe required); and
- detailed design drawings, which include a surveyed plan, cross sections (across the watercourse) and a long section of the watercourse, showing the proposed works relative to existing and proposed bed and bank profiles and water levels. The cross section should extend to the landward limit of the identified riparian corridor.

7.3 ACID SULFATE SOILS

This section refers to any works that disturb the soil in any way.

Objectives

- To ameliorate any existing acid sulfate problems, minimise the release of acid during works and guard against the potential for future acid release.

Relevance of this section

Acid sulfate soils (ASS) will need to be considered for any works that disturb the soil in any way. ASS are widespread in low lying coastal areas, especially in coastal floodplains. It is likely that ASS or potential ASS exist at or close to the soil surface in most coastal wetlands.

Drainage and excavation of actual and potential ASS can result in acid leaching into surrounding soils and waterways. This kills fish and crustaceans, and damages plants and soils. Information on the processes required to minimise the release of acid during restoration works can be found in the New South Wales

Acid Sulfate Soils Management Advisory Committee's *Acid Sulfate Soils Manual* (1988), available from NSW Department of Planning and Environment.

To determine the likelihood of ASS in the area of rehabilitation works, visit the NSW Office of Environment and Heritage (OEH) website. The OEH website contains a series of maps, known as the Acid Sulfate Soils Risk Maps. From these maps, the probability of ASS in a particular area can be estimated and the type of works likely to present an environmental risk identified.

If the land where the rehabilitation works are to be carried out has a high probability of ASS, then an ASS management plan must be submitted as part of the rehabilitation plan. If soils are subsequently found to contain actual or potential ASS, then an ASS management plan must be submitted as part of the rehabilitation plan.

Expert advice will likely be required in the preparation of the ASS management plan. A qualified environmental consultant may be able to provide assistance in the preparation of the plan.

Detail required

A comprehensive work plan, describing all works to be carried out relating to ASS, is to be included in the ASS management plan.

Specific issues to be covered

An ASS management plan must include:

- a description of all works requiring soil disturbance;
- how the works will be staged to minimise impacts;
- how any acid at the site will be managed;
- measures to remove or neutralise any acid-generating potential in the extracted material;
- methods for quality control on the extracted material to minimise offsite impacts and operator liability;
- management of the extracted material storage and processing areas;
- procedures and protocols for leachate and sediment control;
- contingency measures should acid-related incidents occur;
- location and method for disposal of extracted material; and
- monitoring program

7.4 VEGETATION

This section refers to works that encourage regeneration of, or reinstate, the original native vegetation community.

Objectives

- To restore the native vegetation to the composition, structure and form that originally occurred on the site, or as near to original, as possible.

Relevance of this section

This section must be filled out if the native vegetation on the site has been cleared or modified, or if the vegetation will be cleared during, or due to, the rehabilitation works on site.

Consideration must be given to the most appropriate regeneration techniques for each site. The optimal outcome is to restore the naturally occurring community, comprised of locally occurring plants. This can be achieved by one of the following:

Regeneration by soil-stored seed banks

If an area can regenerate from native seed that exist in the soil, the site can be left to regenerate naturally. This is likely in areas that have recently been cleared, and where the original soil profile is in place. If choosing this method, some plants may be planted as a form of erosion and weed control or to establish a nursery habitat for naturally regenerating plants.

Restoration of vegetation by planting

Revegetation by planting is the best method in highly-degraded areas where the original topsoil is not intact. This includes areas where excavation of the topsoil has taken place or where soil from outside the property has been bought in for use as fill as part of development works. This method is also favourable in areas that are weed infested.

Specific issues to be covered

It is important to document the type and rationale for the proposed vegetation program. The revegetation program should include:

An appropriate width for the riparian corridor identified by consulting either Council's DCP, the NSW Office of Water *Guidelines for Riparian Corridors on Waterfront Land or agreed development consent conditions*. The program should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation; consisting of groundcovers, shrubs and trees.

Maps or diagrams which clearly identify the riparian corridor, the existing vegetation, the vegetation to be retained, distance from development, the vegetation to be cleared, and the areas of proposed revegetation.

Consideration of Asset Protection Zones adjacent to watercourses or wetlands. Council's DCP recommends that "*APZs must not be located within the vegetated riparian zone*".

The location of the bed and banks and the footprint of the riparian corridor should be clearly identified. Vegetated riparian zones must be indicated.

Photographs of the site should be supplied and photo points identified. To assist with future monitoring and reporting requirements, the photo points should be identified by GPS coordinate or by survey. This is particularly important for large-scale earthworks and revegetation works.

For steeper slopes and/or degraded sites, soil stabilisation measures such as jute matting maybe required prior to commencing revegetation works.

Vegetation species composition, planting layout and densities should be identified. Refer to Lake Macquarie City Council *Streambank Planting Guide* and *Vegetation Community Profiles Lake Macquarie Local Government Area* (Bell 2015).

The required mix of plant species related to the actual vegetation community to be emulated and the size of the area of areas to be rehabilitated. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.

Seed or plant sources should be identified. Where possible, native plants and seed sources of local provenance should be used.

A chronological plan of the program including staging should be included.

In locations with high populations of rabbits and/or kangaroos, adequate controls (e.g. tree guards) to protect plants should be considered to ensure plant survival.

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Details of the maintenance program (e.g. maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum of 80 per cent survival rate of each species planted and a maximum of five per cent weed cover for the treated riparian corridor area is achieved. No noxious weeds are to be present).

Processes for monitoring and review, including a method of performance evaluation should be identified. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.

7.5 MONITORING

This section refers to post rehabilitation activities required to assess the success of the rehabilitation works.

Objectives

To ensure the project reaches a point where it is stable and looks certain to regenerate fully.

The minimum time period for which a plan is to be implemented is 3 years. At any point the rehabilitation is not progressing satisfactorily, action must be taken to rectify the system failure and, where necessary, implement a plan variation (see section 7.6).

Specific objectives include

To set up a monitoring program that will document that works carried out on site

To track the progress of the rehabilitation;

To provide a mechanism for reporting on the rehabilitation; and

To make provisions for contingency plans if necessary.

Relevance of this section

This section must be covered. Monitoring is required for all rehabilitation to ensure that rehabilitation of the landscape is achieved and regeneration of vegetation is successful in the long term.

Detail required

A monitoring plan must include:

a baseline report to be prepared before rehabilitation is initiated;

milestones and timeframes for rehabilitation;

an assessment regime for recording the progress of the rehabilitation area, to be compared against the ideal;

a mechanism to identify deviation from the anticipated progress of the rehabilitation;

a mechanism for development of a contingency plan;

budget allocation to carry out maintenance works; and

a recording and reporting schedule.

The monitoring plan is not a static plan, but rather a mechanism for actively managing the rehabilitation if it does not go according to the original plan.

Preparation of Rehabilitation Plans for Degraded Watercourses or Water Bodies Guideline

Specific issues to be covered

Map of the site showing photo points and recording locations.

Include quantitative data at relevant sites for:

- erosion;
- sedimentation and/or deposition;
- pH of water bodies and/or soil;
- salinity of water;
- plant survival rate;
- plant growth (including height and density); and
- proportion of weeds to native plants.

The site should be documented before rehabilitation works begin. Ongoing reports should be submitted to Council at least annually for the first two years.

7.6 MAINTENANCE

This section refers to measures undertaken after rehabilitation works have been completed to ensure the success of the rehabilitation works.

Objectives

To ensure the project reaches a point where it is stable and certain to fully regenerate.

The site should be maintained on a needs basis up until the site becomes stable and native vegetation has become established.

Specific objectives include:

To carry out maintenance identified within the monitoring plan

Relevance of this section

Maintenance of the site is essential to the success of rehabilitation works.

Specific issues to be covered

- budget allocation to fund any maintenance works;
- Accountability of persons responsible for implementing the maintenance;
- timeframe for implementation; and
- details of activities to be carried out as part of the maintenance plan.

7.7 SITE PROTECTION

This section refers to measures undertaken after rehabilitation works have been completed to ensure ongoing protection of rehabilitated sites.

Objectives

To allow the soils, water and vegetation of the subject area to be stabilised and restored undisturbed by people, animals or vehicles.

Preparation of Rehabilitation Plans for Degraded Watercourses or Water Bodies Guideline

Relevance of this section

The rehabilitation area requires protection if soil is left exposed or the rehabilitation area or revegetation of the native plant community is in progress and there is any possibility of disturbance, particularly by grazing animals, people or vehicles.

In areas adjoining public lands or for areas that are used as public thoroughfares, signs outlining the reason for protective fencing should be posted to encourage the public to respect the restriction of access to the rehabilitated area.

Detail required

Consideration must be given to the type of fencing to be used – this includes the impact of construction and removal of that fencing. A star picket and wire fence (not barbed) is an example of a low-cost, low-impact fence that can be easily removed when necessary. Signage should also be considered for areas that allow public access or are exposed to public roads or other public land.

The possibility of animals grazing on planted vegetation needs to be considered (e.g. cattle or rabbits). In some circumstances, individual plant protection may be required, such as grow tubes or wire netting, to ensure vegetation can establish.

Specific issues to be covered

This section must include:

- a description of the threats to the area (e.g. public access by foot, vehicle damage, cattle grazing or animal grazing);
- the style of fencing to be constructed (not barbed);
- a map or diagram showing the location of the fence; and
- actual or relative time for the fence to be in position.

Preparation of Rehabilitation Plans for Degraded Watercourses or Water Bodies Guideline

8 REFERENCES

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APPENDIX 1 – Rehabilitation Plan Template

1. Introduction
2. Background information
3. Objectives and strategies
4. Rehabilitation program
5. References
6. Maps