

PART E - SERVICES REQUIREMENTS

E1. DESCRIPTION OF THE SERVICES

E1.1 BACKGROUND

Wingecarribee Swamp is located in the Southern Highlands of New South Wales (NSW) and covers approximately 480 hectares in area (Figure One). Sydney Catchment Authority (SCA) owns and manages the majority of the Swamp and, due to its proximity to Wingecarribee Reservoir, part has been declared a Special Area under Section (44) of the *Sydney Water Catchment Management Act 1998*. The Reservoir supplies drinking water to the Southern Highlands and supplements water supply to the Sydney and Illawarra regions.

In August 1998 heavy rains caused the partial collapse of the Swamp, with an estimated six million cubic metres of peat displaced into the Reservoir. Consequently the Swamp was divided into a number of distinct landform units (Figure one; Kodela *et al.* 2003a).

Delta Area – consists of approximately 136 hectares of swamp or 28% of the post-collapse swamp area and represents the majority of peat that was displaced during the collapse. The delta has partially stabilised in the eastern end of the Reservoir. Major invasion by *Salix* species has occurred in the delta. This unit is the least investigated for plant ecology purposes and provides a rich and diverse study environment.

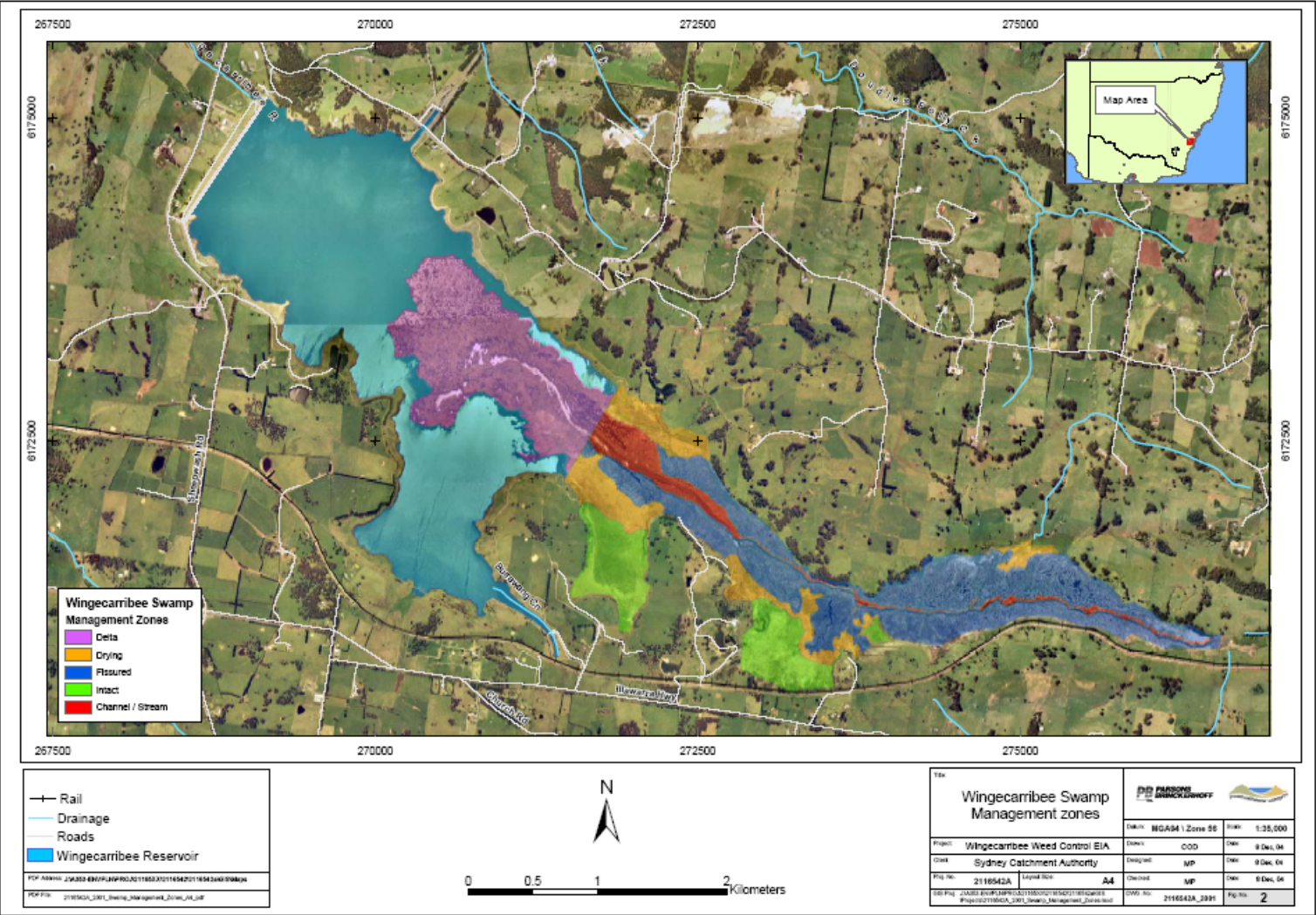
Intact Areas – There are two arms of intact peat on the southern side of the Swamp and a small section on the northern side that collectively account for approximately 65 hectares or 14% of the post-collapse Swamp area. Geophysical investigations and hand auguring in the intact areas indicate peat depth exceeds five metres in some locations (Coffey 2004). Swamp vegetation remains relatively undisturbed in the intact areas providing good baseline of pre-collapse vegetation.

Fissured Areas – account for approximately 183 hectares or 39% of the post-collapse Swamp area. This unit has been highly altered by the swamp collapse and is characterised by fissures, slopes, beds, pools and plateaus. Invasion by *Salix* species is significant in fissured areas. SCA willow-control efforts combined with good water recharge from recent significant rains provide optimism for recovery of swamp vegetation across this unit.

Drying Areas – form an interface between the intact areas and the fissured areas of the Swamp. They account for approximately 62 hectares or 13% of post-collapse Swamp area and have undergone drying and oxidation. Natural regeneration processes and potential implementation of rehabilitation options designed to minimise the drying/oxidation process provide the opportunity for sustained recovery of indigenous swamp vegetation in this region.

Channel Area – a channel bisecting the swamp from east to west was created from the Swamp collapse. Water is received into this channel directly from Caalang Creek in the East and from the extensive drainage network created within the fissured region. The channel has significantly affected the swamp hydrology through rapid drainage of water that would have previously been slowly transmitted within a peat groundwater flow system. A wetland-type vegetation community has developed within this channel unit accounting for approximately 34 hectares or 6% of the post-collapse swamp area.

Figure One: Wingecarribee Swamp Land Units



Threatened Biodiversity and Heritage Significance

Wingecarribee Swamp was considered one of the best examples of a montane peatland in NSW (pre-collapse). The Swamp contains a number of complex vegetation types and diverse flora and fauna listed under both the *Threatened Species Conservation Act 1995* (TSCA) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC). A summary of the listings is provided below.

- Montane peatlands and swamps of the New England Tablelands, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions. Listed as an Endangered Ecological Community under the TSCA. This determination makes specific reference to Wingecarribee Swamp.
- Temperate Highlands Peat Swamps on Sandstone'. Listed as an Endangered Ecological Community under the EPBC. This listing makes specific reference to Wingecarribee Swamp.
- Southern Highlands Shale Woodlands in the Sydney Bioregion. Listed as an Endangered Ecological Community under the TSCA.
- *Gentiana wingecarribiensis* (Wingecarribee Gentian) - listed as Endangered under the TSCA and the EPBC.
- *Lysimachia vulgaris* var. *davurica* (Yellow Loosestrife) - listed as Endangered under the TSCA.
- *Prasophyllum uroglossum* (Leek Orchid) - listed as Endangered under the TSCA and the EPBC.
- *Petalura gigantea* (Giant Dragonfly) - listed as Endangered under the TSCA. `

Wingecarribee Swamp is listed as an item of state natural significance under the NSW Heritage Act (1977). It is a remnant of a late glacial swamp and one of the oldest montane mires known in south-east Australia. It is the northern most significant peatland in NSW. The *Lepyrodia anarthria* open rushland community that previously dominated the swamp was the richest and most extensive of this type known in Australia.

Vegetation Communities - Existing Knowledge

Prior to the collapse in 1998, Wingecarribee Swamp contained high species diversity and a complex mosaic of vegetation types. Twelve vegetation types were identified but not mapped (Kodala 1998).

Vegetation mapping of the Swamp was completed in 1997. Due to the complexity of the Swamp vegetation this mapping identified five broad vegetation types (NSW National Parks and Wildlife Service 1997).

Following the collapse of the Swamp, the habitats have been drastically altered with approximately 80 per cent of the Swamp suffering from major geomorphologic and hydrological changes. As a result of these changes the species composition and distribution has changed and there is a shift of species into newly created microclimates.

During 2001-2002 Sainty and Associates undertook vegetation analysis including quantitative quadrat surveys (Dalby-Ball, M.D. *et al* 2001, Kodala *et al* 2001a, 2001b, 2002, 2003a, and 2003b).

The most recent investigations into the plant communities at Wingecarribee Swamp are documented in Parsons Brinckerhoff (2007). Nine vegetation communities were delineated and mapped during this investigation and these are detailed below and illustrated in Figure Two.

- a) *Carex* sedgeland
- b) *Eleocharis* sedgeland
- c) *Eucalyptus ovata* woodland
- d) *Juncus* wet herbfield

- e) Leptospermum shrubland
- f) Lepyrodia anarthria rushland
- g) Phragmites tall reedland
- h) Salix shrubland
- i) Introduced grassland

The formation of new communities following the collapse includes 'Introduced Grassland' and 'Salix shrubland'. The relationship of these communities to previous vegetation mapping and classification has been cross referenced in Parsons Brinckerhoff (2007). This report is attached to this tender document.

Wingecarribee Swamp and Special Area Plan of Management

The Wingecarribee Swamp and Special Area Plan of Management (WSSAPoM) is the strategic management document for the management of Wingecarribee Swamp. The WSSAPoM was revised during 2006 to detail the management strategy and Key Actions to be implemented for the Swamp over a five year period. The revised WSSAPoM was endorsed for implementation by the NSW Minister for the Environment in 2007.

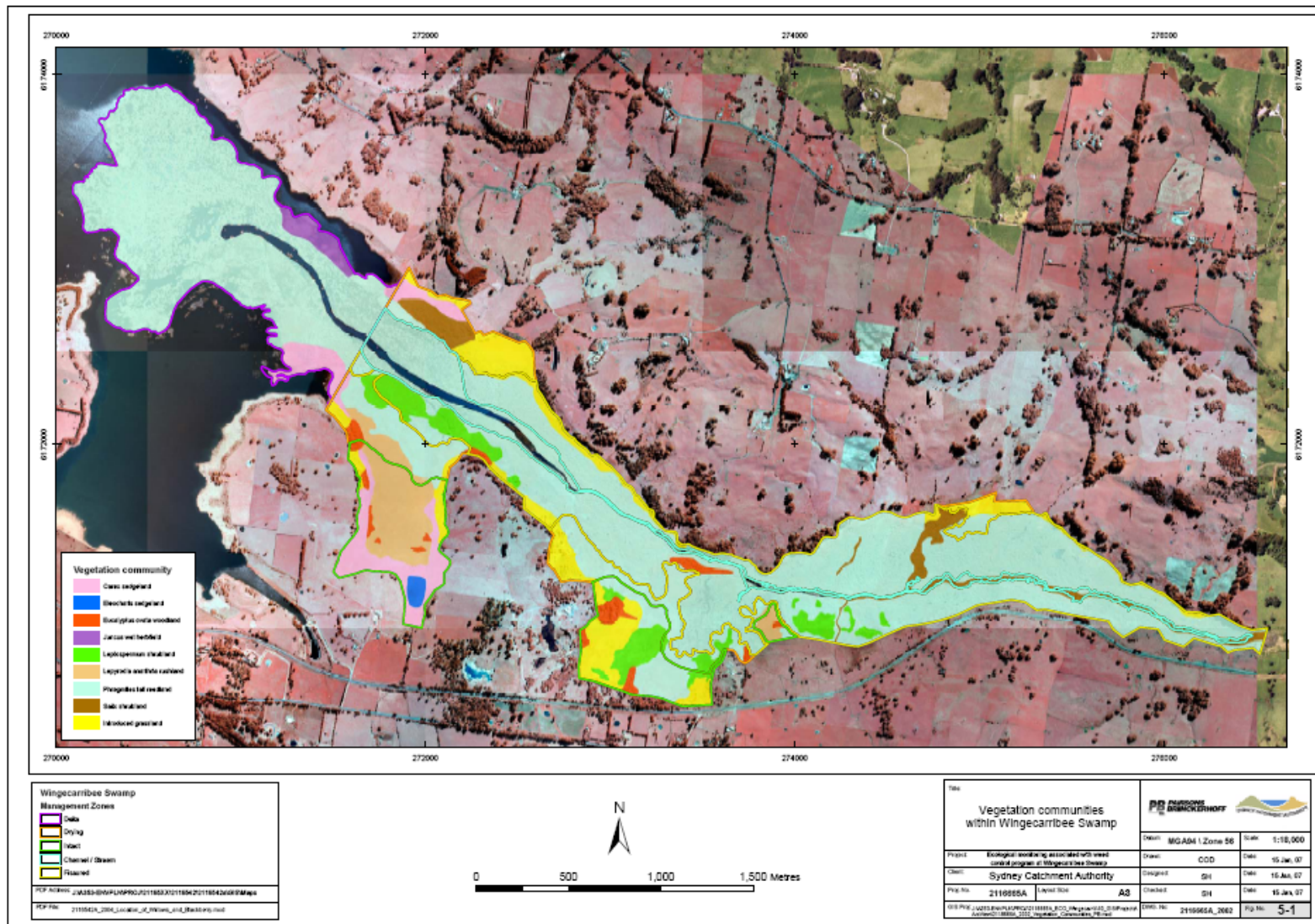
Key Action (2.5) of the revised WSSAPoM requires the SCA to undertake vegetation monitoring for each landform within the Swamp to assess: -

1. Distribution and abundance of plant communities.
2. Spatial and temporal differences in composition.

Annual monitoring is required in permanent monitoring plots and the detailed findings of investigations are to be reported in four years. Key Action (2.5) of the revised WSSAPoM forms the basis for the work specified in this contract. The aims and goals of this monitoring are outlined in Table One (1).

The WSSAPoM also requires the SCA to develop rehabilitation strategies for the Swamp (Key Action 2.8). The proposed vegetation monitoring will provide a basis for developing and monitoring these strategies. Other WSSAPoM programs currently being implemented by the SCA that are designed for remedial purposes include detailed hydrogeological investigations and large-scale willow and blackberry control.

Figure Two: Vegetation Communities as Delineated in Parsons Brinckerhoff (2007)



**TABLE ONE INVESTIGATIVE APPROACH TOWARD PLANT COMMUNITY ECOLOGY STUDIES AT
WINGECARRIBEE SWAMP**

Goals and Objectives	<ol style="list-style-type: none"> 1. To monitor the spatial and temporal changes in the distribution, abundance and composition of plant communities. 2. To identify and determine the importance of factors such as soil moisture, ground water level and weed invasion in influencing the distribution and ecological health of threatened species and plant communities, including endangered ecological communities. 3. Develop recommendations for maintaining /improving the ecological health of plant communities.
Questions	<ol style="list-style-type: none"> 1. What species constitute the plant communities at Wingecarribee Swamp? 2. What is the current distribution of plant communities? 3. What are the spatial and temporal changes in the distribution and composition of the plant communities? 4. What species constitute the endangered ecological communities at Wingecarribee Swamp? 5. What is the current distribution of endangered ecological communities? 6. What are the spatial and temporal changes in the distribution and composition of endangered ecological communities? 7. What are the spatial and temporal differences in soil moisture/ ground water across Wingecarribee Swamp? 8. What is the relationship between threatened species/plant communities and soil moisture content/groundwater level? 9. What is an appropriate range of soil moisture/groundwater for maintaining/improving the ecological health of threatened species and plant communities, including endangered ecological communities? 10. What other factors are influencing the distribution and ecological health of threatened species and plant communities, including endangered ecological communities?
Plan	<ol style="list-style-type: none"> 1. Undertake scientifically based field assessments to determine the distribution and abundance of plant communities at Wingecarribee Swamp and their relationship with soil moisture/ground water. 2. Monitor and map the plant communities over time. 3. Monitor and map the moisture content of peat/soil material over time. 4. Assess the ecological health of threatened species and plant communities and identify factors influencing this health.

Desired Outcomes	<ol style="list-style-type: none"> 1. The species that constitute the plant communities and, in particular, the endangered ecological communities, at Wingecarribee Swamp are identified. 2. The spatial and temporal differences in distribution, abundance and composition of plant communities, including, endangered ecological communities are established. 3. Factors influencing the distribution and ecological health of threatened species and plant communities, including endangered ecological communities, are identified and ranked in terms of importance. 4. The appropriate range of moisture content of peat/soil material is established for threatened species and threatened ecological communities at Wingecarribee Swamp. 5. Future management options for maintaining/improving the ecological health of plant communities are developed.
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E1.2 PURPOSE

The purpose of the work outlined in this Contract is to assist the SCA:

- in understanding spatial and temporal variations in the distribution, abundance and composition of plant communities on Wingecarribee Swamp;
- in understanding the distribution and condition of threatened species and endangered ecological communities;
- in understanding what factors are influencing the distribution and ecological health of threatened species and plant communities;
- in developing options for managing the health of plant communities on Wingecarribee Swamp;
- in partially fulfilling actions under Strategy 2 of the WSSAPoM.

E1.3 SCOPE OF PROFESSIONAL SERVICES

The Services to be provided in accordance with the Contract shall include, but not be limited to, the following:

1. Undertake a review of previous vegetation studies conducted at Wingecarribee Swamp and compile all relevant data.
2. Undertake a replicable quantitative investigation into plant ecology at Wingecarribee Swamp over a three year period.
3. Undertake targeted threatened species and habitat surveys in year 2 and year 3. Note that targeted surveys in year 1 will be undertaken under existing contractual arrangements.
4. Undertake a replicable qualitative analysis and classification of the distribution and ecological condition of plant communities at Wingecarribee Swamp and their relationship with each landform unit.
5. Define the overall endangered ecological communities specific to Federal and State legislative listings associated with Wingecarribee Swamp.
6. Develop a database of all ecological parameters associated with (2), (3) and (4) and where possible incorporate data from (1).

7. Analyse the ecological data/parameters associated with (2), (3) and (4) and any suitable data identified in (1).
8. Identify factors influencing the distribution and ecological health of threatened species and plant communities and rank these in order of importance.
9. Develop management options/recommendations for plant communities at Wingecarribee Swamp.
10. Document and report all aspects of the work associated with the above scope items.
11. Present the work and findings related to the above scope items to an audience of stakeholders.

E1.4 SPECIFICATION

E1.4.1 Review of previous studies and data compilation

The successful tenderer shall undertake a review of previous studies into the plant ecology at Wingecarribee Swamp and compile any relevant data. The review should focus on the distribution and ecological health of plant communities. It is anticipated that this review will rely heavily on reviews previously undertaken by the SCA (Parson Brinckerhoff 2005 and Sydney Catchment Authority 2007b). Relevant questions to guide the review process are provided below: -

1. What species constitute the plant communities and, in particular, endangered ecological communities?
2. What is the distribution and abundance of the species that constitute plant communities and in particular, endangered ecological communities?
3. Have changes to the distribution and abundance of the species that constitute plant communities been identified?
4. What is the distribution of threatened species and their habitats?
5. What are the spatial and temporal differences in soil moisture/groundwater across Wingecarribee Swamp?
6. What is the relationship between threatened species/ plant communities and soil moisture /groundwater?
7. What other factors may be influencing the distribution and ecological health of threatened species and plant communities including endangered ecological communities?
8. What potential rehabilitation/remediation options for threatened species and plant communities have previously been identified?
9. What data from previous studies can be incorporated into the current study to aid in determining spatial and temporal changes in threatened species and the distribution of plant communities at the Swamp?
10. What methodologies/survey techniques have previously been used including quadrat/ transect techniques and confidence levels of the data.

A substantial list of literature is available on plant ecology relevant to the Swamp. Key relevant resources to be supplied to the successful tenderer by the SCA are listed below.

1. Cremer, K. 2002, Assessment of *Salix cinerea* (Wild Pussy Willow) at Wingecarribee Swamp, Report to Sydney Catchment Authority, Cooma.
2. Dalby-Ball, M.D., Roberts, D., Kodala, P.G., Bravo, F.J., and Sainty, G.R. (2001) Quantitative sampling for vegetation in Wingecarribee Swamp: Autumn 2001. Sainty and Associates.

3. Enviroquest 2006, *2006 annual progress report: Wingecarribee Swamp weed control*, Enviroquest.
4. Kodela, PG. 1998, *Wingecarribee Swamp and Reservoir wetland complex: preliminary re-assessment of its heritage values and the Ramsar criteria after the August 1998 environmental damage, including concepts for rehabilitation and management*, Sydney Royal Botanic Gardens, Unpublished report prepared for the NSW Heritage Office, Sydney.
5. Kodela, PG, James, TA & Hind, PD 1994, 'Observations on the ecology and conservation status of the rare herb *Gentiana wingecarribiensis*', *Cunninghamia*, vol. 3, no. 3, pp. 535-41.
6. Kodela, PG, Sainty, GR, Bravo, FJ, and James, TA, 2001a, Wingecarribee Swamp flora survey and related management issues. Sainty and Associates Pty Ltd, Potts Point.
7. Kodela, PG, Bravo, FJ, James, TA, and Sainty, GR 2001b, *Quantitative sampling for vegetation in Wingecarribee Swamp – spring 2001*, Sainty and Associates Pty Ltd, Potts Point.
8. Kodela, PG, Bravo, FJ, Sainty, GR and Roberts, D , 2003a, Analysis of data from four quantitative flora surveys of Wingecarribee Swamp undertaken in 2001 and 2002, and an assessment of changes with recommendations. , Sainty and Associates Pty Ltd, Potts Point.
9. Kodela, PG, Bravo, FJ, James, TA, Sainty, GR & Olsen, AR 2003b, *Quantitative sampling for vegetation in Wingecarribee Swamp - spring/summer 2002 survey*, Sainty and Associates Pty Ltd, Potts Point.
10. NSW National Parks and Wildlife Service 1997, *Wingecarribee Swamp broad vegetation classification*. Unpublished, NSW National Parks and Wildlife Service, Hurstville.
11. Parsons Brinckerhoff 2004, *Wingecarribee Swamp weed management program- Review of Environmental Factors*, 2116448A PR_9427, Parsons Brinckerhoff, Rhodes.
12. Parsons Brinckerhoff 2005, *Ecological Survey of Wingecarribee Swamp Relevant to the Approved Weed Control Program*, Parsons Brinckerhoff, Sydney.
13. Parsons Brinckerhoff 2007, *Ecological monitoring associated with weed control program at Wingecarribee Swamp 2005-2006*. Parsons Brinckerhoff, Sydney (Supplied with tender document).
14. Sydney Catchment Authority & NSW National Parks and Wildlife Service 2006, *Wingecarribee Swamp and Special Area Plan of Management*, Sydney Catchment Authority.
15. Sydney Catchment Authority 2007a *Briefing paper on potential remediation options for Wingecarribee Swamp* (Draft internal document).
16. Sydney Catchment Authority 2007b *Ecological Condition of Landform Units in Wingecarribee Swamp* (Draft internal document).
17. Urban Bushland Management 2006, *Wingecarribee Swamp weed control works annual report, Season 1: 2005-2006*, Urban Bushland Management, Castle Hill.

E1.4.2 Quantitative Investigations

The successful tenderer shall undertake quantitative investigations into the plant ecology in each landform unit at Wingecarribee Swamp. The purpose of the quantitative investigations is to measure the distribution and abundance of plants on a spatial and temporal scale. Specific requirements of the work are as follows: -

- There shall be six field-based surveys conducted. One in spring and one in autumn for each of the three survey years i.e. 2008/2009, 2009/10, and 2010/11. Two surveys per year

are scheduled in order to capture the spring and autumn temporal variation in plant communities.

- The experimental design of the quantitative investigations shall be replicable to enable continuation of plant community studies beyond this Contract.
- Investigation plots shall include at least some fixed quadrats and the quadrats should be strategically established to best capture the spatial distribution of the plant communities. Sampling design shall be consistent with contemporary scientific methodology including appropriate confidence limits for suitable statistical analysis. .
- Fixed sampling units need to have permanent identifiable markers and the name of each quadrat clearly identified.
- The design should ensure that previous data collected from the swamp can be incorporated into any analysis undertaken where appropriate.
- The design should be flexible to allow for incorporation of monitoring plots for any remedial actions undertaken by the SCA during the term of the contract such as continued monitoring of weed control impact plots established by Parsons Brinkerhoff (2007) in year 2 and 3 of the contract or monitoring of any remedial structures installed into the swamp.

The minimum number of parameters to be identified, recorded and incorporated into a database for each quadrat shall be as follows: -

1. Date.
2. Geo-referenced location.
3. Land unit.
4. CAPS code.
5. Species.
6. Abundance (individual count) of each plant species and/or
7. Percent projected foliage cover of each individual species.
8. Moisture condition at the surface of the soil medium.
9. Depth to groundwater from soil surface.
10. Total percent cover of dead vegetation for the whole quadrat.
11. Bare ground percent cover.
12. Photo reference

It is expected that similar parameters would be recorded for any transects undertaken.

E1.4.3 Targeted threatened species surveys and habitat condition assessment

The successful tendered shall undertake targeted threatened species surveys in years 2 and 3 of the contract i.e. 2009/2010 and 2010/2011. Note that targeted surveys in the 2008/2009 financial year will be undertaken under exiting contractual arrangements. Data from these surveys will be made available to the successful tenderer once completed.

These surveys will cover the target the following species and their habitats:

- *Gentiana wingecarribiensis* (Wingecarribee Gentian) - listed as Endangered under the TSCA and the EPBC.
- *Lysimachia vulgaris var. davurica* (Yellow Loosestrife) - listed as Endangered under the TSCA.
- *Prasophyllum uroglossum* (Leek Orchid) - listed as Endangered under the TSCA and the EPBC.
- *Petalura gigantea* (Giant Dragonfly) - listed as Endangered under the TSCA.

The surveys will be undertaken at appropriate times of the year to maximise detection success.

The successful tender shall also undertake a condition assessment of the threatened species and identified habitats

Factors to be considered for incorporation into this assessment include: -

1. Distribution and abundance of the species and their habitats including appropriate GIS maps (building on work already undertaken by Parsons Brinkerhoff 2005/2007).
2. Relationship of the species to identified land units.
3. Temporal changes in the distribution and abundance of the species and their habitats over time.
4. Ecological health of the species and their habitats
5. Identification of factors influencing the ecological health of the species and their habitats including ranking the importance of these factors.
6. Peat moisture condition/ depth to groundwater and their relationship with the ecological health of the species and their habitats
7. Extent and impact of introduced species on the plant community.

E1.4.4 Qualitative Analysis of Plant Communities

The successful tenderer shall undertake a qualitative analysis of the plant communities at Wingecarribee Swamp during 2008/2009 and 2010/2011. The purpose of the qualitative analysis is to assess the distribution and ecological health of the plant communities. The 2008/2009 survey would form a baseline assessment and would be used to benchmark ecological health and condition of plant communities in future years. It is anticipated that the distribution of plant communities would rely heavily on work already undertaken (Parson Brinckerhoff 2007 and Sydney Catchment Authority 2007b). The 2010/2011 assessment would allow analysis of temporal change. Data from previous studies identified in E 1.4.1 shall be incorporated into this temporal analysis where possible.

The successful tenderer shall develop and implement a methodology to assess distribution and ecological health including resilience of plant communities. The methodology must be replicable to enable comparative investigation and analysis over extended periods of time. The methodology shall be designed to measure the ecological health of the plant communities.

Factors to be considered for incorporation into this assessment include: -

1. Distribution and abundance of the plant community including appropriate GIS maps.
2. Relationship of plant communities to identified land units.
3. Species diversity and abundance of each plant community including any temporal changes.
4. Condition of plants within the community i.e. dead, dying, stunted growth, water stressed.
5. Peat moisture content/ depth to groundwater and their relationship with plant community distribution, landform unit and ecological health and condition.
6. Extent and impact of introduced species on the plant community.
7. Other factors influencing ecological health and resilience of plant communities including ranking these factors in terms of importance.

E1.4.5 Definition of Endangered Ecological Community relevant to Federal and State Listings

The successful tenderer shall define the endangered ecological communities specific to Wingecarribee Swamp associated with Federal and State legislative listings. These definitions shall be based on the findings from the literature review, field investigations and data analysis.

The definition of the specific endangered ecological communities shall include a detailed understanding of the following parameters: -

1. Species composition of the endangered ecological communities at Wingecarribee Swamp.
2. Distribution of the endangered ecological communities at Wingecarribee Swamp including GIS mapping.
3. Parameters specified in each specific Federal and State legislative listing.

The title of the listings under the specific legislation is provided below: -

- *Threatened Species Conservation Act 1995*- listed as 'Montane peatlands and swamps of the New England Tablelands, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions'. Listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*.
- *Environment Protection and Biodiversity Conservation Act 1999*. Listed as 'Temperate Highland Peat Swamps on Sandstone'. Listed as an Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act*.
- Southern Highlands Shale Woodlands in the Sydney Bioregion. Listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*.

E1.4.6 Ecological Database

The successful tenderer shall develop an ecological database for Wingecarribee Swamp. The database shall be developed in Microsoft Access and include data collected as part of both the qualitative and quantitative components of this contract. Where compatible, data identified during the literature review process should also be incorporated.

The database shall include appropriate meta data including the source of all data, data collection methods and accuracy and confidence of the data.

E1.4.7 Analysis of Ecological Data

Analysis including univariate and/or multivariate statistical interpretation shall be undertaken on the ecological data set. The principle objective of the analysis shall be to determine the spatial and temporal differences of plant communities at Wingecarribee Swamp and identify factors that may be influencing any changes.

Important questions considerations to guide the analysis and interpretation from the ecological data set are summarised below: -

1. Identification of specific plant communities at Wingecarribee Swamp.
2. The species composition of individual plant communities
3. The size, extent and location of individual plant communities.
4. The relationship between plant community distribution and landform unit.
5. The spatial and temporal differences in soil moisture/depth to groundwater across Wingecarribee Swamp.

6. The relationship of plant community distribution and ecological health with soil moisture content and depth to groundwater.
7. The relationship of the distribution and health of threatened species with soil moisture content and depth to ground water.
8. Increasing or decreasing distribution of threatened species or their habitats
9. Increasing or decreasing distribution of individual plant communities.
10. Changes to species composition within individual plant communities.
11. Identification of risks to the ecological health of each threatened species and plant community. Possible risks include invasion by introduced species and changes to moisture content. Risk should be quantified in terms of consequence.
12. Determination of the appropriate range of soil moisture /depth to groundwater for maintaining the ecological health of the plant communities and threatened species.

Important WSSAPoM performance indicators to be established, monitored and reported each year for the delta, drying, intact, fissured and channel landform units include: -

- Extent and condition of threatened species and communities.
- Extent, type and condition of vegetation cover (measured in hectares and percentage of total vegetation in catchment).
- Extent of the threat to ecological integrity (measured in hectares or abundance).
- Assessment of the risk of the threat to ecological integrity (measured in likelihood and consequence).

E1.4.8 Management Options and Recommendations

The successful tenderer shall propose management options/recommendations to improve the plant community ecological health and condition at Wingecarribee Swamp. Options/recommendations shall be based on: -

- Findings and outcomes from the work specified above
- Detailed consideration of management strategies and Key Actions of the WSSAPoM.

Estimates of the cost and timeframes for the implementation of each management option/recommendation are to be provided.

E1.4.9 Submission of methodology

Prior to undertaking any field work the successful tender shall submit a detailed methodology for review and approval by the SCA. This methodology must be submitted at least 1 month prior to the commencement of fieldwork. The methodology should include, as a minimum:

- sampling locations;
- sampling methods (details of quadrats/transects or other appropriate method);
- Parameters to be recorded;
- statistical analysis to be conducted on data (where applicable);
- mapping procedures (where applicable) ;
- methods for assessing soil moisture (surface level and groundwater).
- methods for assessing ecological condition and health (where applicable).
- Database construction details including fields to be included and incorporation of meta data.

E1.4.10 Reporting Requirements

The successful tenderer shall be required to deliver one electronic copy and one hard copy of all draft reports and one electronic copy and three hard copies of final reports to the SCA Project Manager.

The reports may be presented and formatted based on professional judgement. However, for each report, the SCA Project Manager must approve the report format and structure prior to delivery of the first draft. Approval for the report format and structure shall be through the issue of a draft Table of Contents from the successful tenderer.

The prepared reports shall include requirements of the specification items E1.4.1- E4.8. For ease of reference specific the titles for these specification items are repeated below.

E-1.4.1 – Review of previous studies and data compilation

E-1.4.2 – Quantitative Investigations

E-1.4.3 – Targeted threatened species surveys and habitat condition assessment

E-1.4.4 – Qualitative Analysis of Plant Communities

E-1.4.5 – Definition of Threatened Ecological Community relevant to Government Listings

E-1.4.6 – Ecological Database

E-1.4.7 – Analysis of Ecological Data

E-1.4.8 - Management Options and Recommendations

Report number	Report Title	Specified Work	Timeframe for Draft Report	Timeframe for Final Report
1	Quantitative Investigations and Analysis of Plant Community Ecology at Wingecarribee Swamp –Spring 2008/ Autumn 2009	E.1.4.1 E.1.4.2 E.1.4.6 E.1.4.7 E.1.4.8	1 May 2009	Two (2) weeks from receipt of SCA comments on draft report.
2	Quantitative Investigations and Analysis of Plant Community Ecology at Wingecarribee Swamp – Spring 2009/ Autumn 2010	E.1.4.1 E.1.4.2 E.1.4.3 E.1.4.6 E.1.4.7 E.1.4.8	1 May 2010	
3	Quantitative Investigations and Analysis of Plant Community Ecology at Wingecarribee Swamp – Spring 2010/ Autumn 2011	E.1.4.1 E.1.4.2 E.1.4.3 E.1.4.6 E.1.4.7 E.1.4.8	1 May 2011	
4	Qualitative analysis and classification of the plant communities at Wingecarribee Swamp in 2008/2009	E.1.4.1 E.1.4.2 E.1.4.4 E.1.4.5 E.1.4.6 E.1.4.7 E.1.4.8	1 May 2009	

Report number	Report Title	Specified Work	Timeframe for Draft Report	Timeframe for Final Report
5	Qualitative analysis and classification of the plant communities at Wingecarribee Swamp in 2010/2011	E.1.4.1 E.1.4.2 E.1.4.3 E.1.4.4 E.1.4.5 E.1.4.6 E.1.4.7 E.1.4.8	1 May 2011	Two (2) weeks from receipt of SCA comments on draft report.
6	Ecological Monitoring of Wingecarribee Swamp 2008 - 2011: Final Report	E.1.4.1 E.1.4.2 E.1.4.3 E.1.4.4 E.1.4.5 E.1.4.6 E.1.4.7 E.1.4.8	1 May 2011	

Where applicable maps, including shape files, and databases will be supplied electronically with the delivery of the above reports.

Combining reports with the same delivery date may be possible after discussion and agreement with the SCA Project Manager.

E1.4.11 Presentation Requirements

The successful tenderer shall undertake a formal presentation of ecological investigations, findings, outcomes and management options to the SCA and interested stakeholders. The scope items associated with the presentation specifically relate to the following: -

- E-1.4.1 – Review of previous studies and data compilation
- E-1.4.2 – Quantitative Investigations
- E-1.4.3 – Targeted threatened species surveys and habitat condition assessment
- E-1.4.4 – Qualitative Analysis of Plant Communities
- E-1.4.5 – Definition of Threatened Ecological Community relevant to Government Listings
- E-1.4.6 – Ecological Database
- E-1.4.7 – Analysis of Ecological Data
- E-1.4.8 - Management Options and Recommendations

The presentation would be held in a SCA presentation room to be advised at a date around April/May 2011. The presentation shall be developed to address scientific, regulatory and operational aspects of the ecological investigations. It is envisaged that the presentation and answering of any subsequent questions would be approximately 1 hour in duration. Audio visual equipment and whiteboard facilities would be provided by the SCA at request of the successful tenderer. The successful tender should include a cost for presentations in the schedule of rates in the event that further presentations are required.

E1.4.12 Site Accessibility

The successful tender needs to be aware of the following in relation to site access:

- Wingecarribee Swamp can only be accessed through gates that are opened with SCA Keys. Access to the site can only be achieved through prior arrangement with the SCA Project Manager who will arrange for the temporary issue of a key.
- Access to the site is generally through private property. The SCA has arranged access agreements with a limited number of property owners. Access will be restricted to SCA properties and to those properties with access agreements.
- Access to the delta area is primarily by boat. With prior arrangement the SCA Project Manager will arrange a suitable boat and driver to transport personnel to the area. Boating access is limited to suitable weather conditions and may need to be rescheduled at short notice. It is possible to access parts of the delta with a non-powered boat such as a canoe. Any requirement to access with a non-powered boat must be approved by the SCA Project Manager.
- Wingecarribee Swamp poses a number of hazards for personnel accessing the site. The terrain is uneven with damp peat and water holes in many areas. A minimum of two people shall work together while accessing the Swamp.
- The successful tender shall comply with the SCA's *Lone and remote worker policy* when conducting field work including logging in and out with the SCA's service provider.
- Mobile phone reception in and around the swamp is unreliable and variable.
- The successful tender shall notify the SCA Project Manager of their location each time they propose to enter the Swamp.

Wingecarribee Swamp is a no smoking area.