

ATTACHMENT A

Comments on Response to Submissions Prepared by Dr Colin Bower (FloraSearch) in relation to the THPSS ECC Interpretation for the BHP Bulli Seam Project

1. DECCW sought the Commonwealth's view on whether the upland swamps of the Woronora Plateau are part of the THPSS listing under the Environment Protection Biodiversity Conservation Act (specifically map unit FRW p129, which occurs in the Bulli Seam Operations Area, in addition to map unit p130, which is already mentioned in the Commonwealth listing). The Department of Environment, Water, Heritage and the Arts (DEWHA) consider the Woronora Swamps to be consistent with the THPSS listing. They acknowledge that the listing currently states that THPSS occurs from "around 600m-1200m above sea level", which is mostly higher than the Woronora Swamps. Elsewhere in the listing however, some swamps below 600m are specifically included within THPSS. Due to these contradictions in the listing, DEWHA is seeking legal advice as to whether or not swamps consistent with THPSS but below 600m are captured by the current listing.
2. DECCW prepared its own detailed evaluation of whether the THPSS community occurs in the proposed Bulli Seam Operations Area, as mapped in vegetation unit FRW p129 of Tindall et al (2004) based on advice from its specialist scientific staff. A copy of this advice is attached for the Commission's information at Attachment B.
3. Some of the interpretation ambiguities arise because of some inaccuracies in the Commonwealth listing statement. For example, the title Temperate Highland Peat Swamps on Sandstone describes the community as occurring on sandstone, but major examples cited in the listing statement are variously on basalt, shale and metasediments (for example, Jacksons Bog, Paddys River swamps, Wildes Meadow, Wingecarribee swamp) – not sandstone. Similarly, the elevational range is loosely indicative, and not always consistent with examples in the literature cited in the listing statement. Swamps ascribed to the THPSS in the Blue Mountains as map unit 26a of Benson (1992) descend to 390m on the Paterson Range near Bilpin, while those mapped as unit FRW p130 by Tindall et al (2004) also extend as low as 300m on the Woronora Plateau. While the THPSS generally occurs at altitudes around 600–1200 m across its range from the central tablelands to the Victorian border, it is difficult to see how occurrence outside this indicative elevational range would be sufficient basis to exclude swamps from the listed community, given that the listing statement refers to literature that describes examples outside those indicative thresholds.
4. The range of peat in soils within swamps of the Woronora are indistinguishable from other examples of THPSS in the Blue Mountains. Soils of swamps in both regions include areas with minimal or no peat content on their seasonally dry margins, with peat content up to 60 per cent dry weight (>60 per cent by volume) along the more poorly drained central axis. Thus, one could point to areas of low peat content, but virtually all medium and large-sized swamps on the Woronora have some areas of appreciable peat content, as is the case with examples of THPSS from other regions. It is therefore difficult to see how swamps on the Woronora Plateau could be excluded from THPSS on the basis of peat content.
5. The composition of the species assemblage is the primary feature relevant to the identification of listed ecological communities (both State and Commonwealth legislation refer to the 'assemblage of species' in their definitions of ecological communities). THPSS exhibits some variation in species composition, with the greatest differences evident between swamps of the Blue Mountains and those of the southern highlands and southern tablelands (for example, Wingecarribee swamp, Jacksons Bog). For example, a number of species cited in the listing occur in swamps of the Blue Mountains (*Boronia deanei*, *Grevillea acanthifolia* subsp. *acanthifolia*) but do not occur in swamps of the southern tablelands even though swamps of both regions are included within THPSS. Thus, the scarcity or absence of individual species cannot be strong grounds for the exclusion of certain swamps from THPSS. The full spectrum of species in the assemblage must be considered to assess whether an area is part of a particular ecological community. On this basis, Woronora

swamps contain a high proportion of the species mentioned in the THPSS listing, and are therefore likely to be part of that community. Furthermore, the swamps of the Woronora are much more similar to those of the Blue Mountains than the southern examples of THPSS are to Blue Mountains. Thus if the Blue Mountains swamps are part of THPSS, it is difficult to see how the floristically similar swamps of the Woronora can be excluded from the listing.

6. Regarding, species of *Sphagnum*, these are typical of swamps on the southern tablelands but are not common in swamps of Blue Mountains. As both of these are part of THPSS, the scarcity of *Sphagnum* on the Woronora Plateau provides no grounds for excluding Woronora swamps from THPSS. As noted above, the valid diagnosis of ecological communities requires that the assemblage of species must be assessed overall, rather than placing undue emphasis on individual species.
7. It is noteworthy that there are appreciable numbers of swamps that fit the description of THPSS on the southern tablelands (for example, around the eastern rim of the Monaro tableland, on the Morton plateau), which are also not mentioned specifically in the listing statement. Details of these can be provided if needed. The examples given in listing statements are not intended to be exhaustive, and the Commonwealth readily acknowledges that there may be occurrences of THPSS other than those listed.

ATTACHMENT B

A comparison of the characteristics of Woronora Plateau swamps and the Temperate Highland Peat Swamps on Sandstone endangered ecological community

Summary

Temperate Highland Peat Swamps on Sandstone (THPSS) were listed as an endangered ecological community (EEC) under the EPBC Act on 12th May 2005. The characteristics of the upland swamps of the Woronora Plateau appear to be consistent with those described in the THPSS listing. Two broad types of swamps have been mapped on the Woronora Plateau by Tozer et al (2006). These are FRW p129 Coastal Upland Swamp and FRW p130 Blue Mountains – Shoalhaven Hanging Swamps. The EPBC Act listing specifically recognises Blue Mountains – Shoalhaven Hanging Swamps as part of the THPSS EEC, but is silent about Coastal Upland Swamps.

The Commonwealth listing provides information on the species assemblage, distribution, geology, geomorphology and altitudinal range of THPSS. It also provides examples of THPSS and indicates which mapped vegetation types fall within the scope of the EEC. The purpose of this analysis is to examine the characteristics of all swamps of the Woronora Plateau and to determine whether they satisfy the definition of THPSS.

The main conclusions are that the map unit FRW p129 Coastal Upland Swamp defined by Tozer et al. (2006) is part of THPSS. This unit forms a continuum of swamp vegetation on Woronora Plateau with FRW p130 Blue Mountains – Shoalhaven Hanging Swamps, which is explicitly included within the listing of THPSS. The structure of the vegetation within FRW p129 is consistent with the THPSS listing, and many of the species listed as characteristic of THPSS occur throughout the Woronora Plateau, particularly within FRW p129. A number of Woronora swamps are specifically listed as part of the EEC. The geomorphic, hydrological and climatic characteristics of the Woronora swamps are consistent with the listing. The listing specifically includes one of the two vegetation types found in the Woronora swamps (FRW p130) as part of THPSS. The other extensive vegetation type within the Woronora swamps is FRW p129. The local differences in floristic composition between FRW p129 and FRW p130 are subtle relative to the variation in floristics encompassed by the totality of the THPSS listing, which includes bogs and fens scattered throughout the central and southern tablelands of NSW (mapped by Tozer et al. 2006 as units FRW p57 and FRW e59), including a number of swamps that occur on non-sandstone substrates. Furthermore, Tozer's et al. (2006) floristic analysis shows that these two units are sister groups, while other map units also included within THPSS (FRW p57 and FRW e59) are part of another grouping of swamp assemblages. Hence, if FRW p130 is part of THPSS, then FRW p129 must also part of the THPSS EEC to preserve logical consistency of the listing. More detail on each of these points follows.

Distribution

The listing considers that THPSS occur in the Blue Mountains (including Newnes Plateau), the Southern Highlands and south of Bombala. Butlers Swamp, Gallahers Swamp, North Pole Swamp, Rock Arch Swamp and Stockyard Swamp are specifically mentioned under the heading of Southern Highlands Swamps. All of these swamps occur on the Woronora Plateau.

The listing appears to be somewhat inconsistent in its description of the distribution of upland swamps. The section dealing with the Blue Mountains is the most comprehensive, referring to all swamps in the major catchments, including those on Newnes Plateau. On the other hand, the sections dealing with the Southern Highlands & southern NSW mention a number of specific swamps by way of example, but there are a number of omissions of swamps within the overall range, which appear to be highly likely to be part of the listed community. Examples of swamps that have not been mentioned include most of those on the Woronora Plateau, Little Forest Plateau in Morton National Park, the swamps on eastern part of the Monaro Tableland and the nearby southern escarpment (eg Bega Swamp, Nunnock Swamp, Killarney Swamp, all of which are similar to, and north of Jacksons Bog). These swamps share similar characteristics, and some are in close geographic proximity, to those mentioned in the listing statement.

Geology, geomorphology, soil and hydrology

The EPBC Act listing states that THPSS are associated with Triassic sandstone in the Blue Mountains. They occur in shallow valleys with low gradients. They often occur in the headwaters of these valleys, but can also occur on gently sloping valley floors or alluvial flats in more incised valleys. They also occur on steeper hillsides or valley slopes where they are associated with groundwater seeping along impermeable rock layers such as claystone reaching the surface. On the southern Tablelands, THPSS can be associated with Permian sandstones. At Wingecarribee Swamp, the listing considers that the swamp is fed by springs seeping along the boundary of basalt and sandstone. However, the Wollongong geology map that covers this area suggests that the sedimentary rocks in this catchment are dominated by shale. In southern NSW, Jacksons Bog occurs on Ordovician sediments that include sandstone, but mudstones and claystones are the dominant lithology.

THPSS occur on acidic peaty soils with moderate to high levels of organic matter and a sandy to loamy texture. They are permanently to periodically waterlogged, with peat depths ranging from about 1 cm to several meters. The hydrological, geomorphological and lithological characteristics of the Woronora swamps are consistent with the listing, which draws upon a specific study of the Woronora swamps, ie Young and Young (1988).

While the listing mentions specific swamps on the Woronora Plateau, it does not discuss their geology, geomorphology or soils. The Woronora Plateau is dominated by sandstone, primarily the Hawkesbury and Mittagong formations (NPWS 1993). The Mittagong Formation which has intergrading sandstone and shale is primarily located on the western edge of the plateau. The swamps are concentrated in the higher rainfall areas to the east, where Hawkesbury Sandstone is the dominant rock type. In Australia, upland swamps are most extensive in the high rainfall areas of Tasmania. On mainland Australia, they are restricted to poorly-drained headwater valleys (Keith and Myerscough 1993). The Woronora Plateau represents the largest concentration of upland swamps in mainland Australia. Most occur in valley headwaters, with a smaller number occurring either in low gradient sections of incised valleys or on steeper hillsides associated with lateral seepage of groundwater. The soils range from deep peats with high levels of organic matter in permanently wet areas to sandy soils with little or no peat in areas that periodically dry out. The geology, geomorphology and soils of the Woronora Plateau swamps appear to be entirely consistent with characteristics described in the THPSS listing.

Climate and altitude

As THPSS occur on at least periodically waterlogged soils, they are concentrated in areas with relatively high rainfall. The listing suggests that annual rainfall generally ranges from 750-1600mm, though swamps in lower altitudes can receive as little as 500mm. This represents a wide climatic envelope, but swamps will only occur where the soil is at least periodically waterlogged (Keith, 1994). Waterlogged soils occur where combined water input from precipitation, runoff and groundwater seepage exceeds total water loss from runoff and evaporation. The soil water balance is not static and the extent of swamps can change in response to changes in soil moisture. On the Woronora Plateau, Keith *et al* (2006, 2009) recorded an increase in the extent of upland swamps and a corresponding decrease in the extent of woodland over a 40-year period (1960-2000), which coincided with a period of declining evaporation. Average annual precipitation on the Woronora Plateau is within the range mentioned in the listing, varying from 1550mm at Maddens Plains in the east to 850mm at Wedderburn in the west (Australian Bureau of Meteorology, unpub. data).

The listing states that THPSS generally occur at elevations from about 600 meters up to about 1200 meters. An analysis of the elevation of the swamps specifically mentioned in the listing suggests that the lower end of this elevation range is indicative. Specifically, map unit 26a of Benson (1992) occurs as low as 390 meters along the Paterson Range near Bilpin. The same map unit in Keith and Benson (1988) occurs down to 500 meters near Mt Whaite on Kings Tableland. Gallahers Swamp in the upper reaches of a tributary of the Avon River on the Woronora Plateau is at 530 meters elevation. Map unit FRW p130 of Tozer *et al* (2006) occurs as low as 300 meters on the Woronora Plateau and 500 meters on Little Forest Plateau in Morton National Park. Most swamps of the Woronora plateau occur at elevations above 300 meters.

Flora and fauna

The listing describes the structure of the vegetation of THPSS and refers to the species typically found in swamps in the Blue Mountains, Southern Highlands and at Jacksons Bog. THPSS includes sedgeland, closed sedgeland, open rushland, open heath, closed heath, tussock grassland, closed tussock grassland, tall closed grassland, open scrub and tall shrubland. The vegetation is usually less than 3 meters high, though taller shrubs may be present. Emergent trees may occur on swamp margins. The vegetation of the Woronora Plateau swamps varies with soil moisture and nutrients (Keith and Myerscough, 1993), but generally falls within the description of THPSS. The swamps include areas dominated by shrubs, Cyperaceae and Restionaceae and appear to encompass all of the various structural variants described in the listing other than grassland. Hence, this aspect of the vegetation of the Woronora swamps is largely consistent with the listing. The listing mentions about 121 plants that have been recorded in THPSS, drawn from a variety of references, but not including the more significant vegetation surveys that included the Woronora Plateau swamps (eg . Keith and Myerscough 1993, Keith 1994, NPWS 2003, Tozer et al 2006). Nevertheless, 50 species out of the 121 from the listing or 41% have been recorded in the swamps of the Woronora Plateau, a high proportion given that the Woronora Plateau represents a small portion of the total range of THPSS.

The listing also mentions vegetation studies that have described and mapped THPSS. It specifically mentions that map unit FRW p130 Blue Mountains – Shoalhaven Hanging Swamps of Tozer et al (2006) equates with THPSS in the Blue Mountains. The map unit FRW p130 is also mapped on the Woronora Plateau, but mention of this map unit is not repeated under the heading dealing with studies in the Southern Highlands. Reference to the map produced by Tozer et al (2006) shows that the Woronora Plateau swamps specifically mentioned in the listing are either mapped as FRW p130 or a mixture of FRW p130 and FRW p129. Map unit FRW p129 occurs as high as 630 meters in the headwaters of the Nepean River on the Woronora Plateau, while FRW p130 occurs down to 300 meters. This indicates that there is a broad altitudinal overlap between the two vegetation types of the Woronora swamps as opposed to a distinct altitudinal cutoff. The overlapping species composition of these two units further suggests a close relationship between them.

Tozer *et al* (2006) map approximately 2100 ha of FRW p130 on the Woronora Plateau and approximately 1800 ha of FRW p129 Coastal Upland Swamp. The differences between the two communities are subtle, as evidenced by the quote about FRW p129 from Tozer et al (in press) “... shares a number of its most abundant species with Blue Mountains - Shoalhaven Hanging Swamps (FRW p130), which is generally found on sandstone plateaux extending to higher elevations. The overall floristic differences between the two units relate to a trend of increasing plant diversity as altitude declines and some local endemism in the upper altitudinal range of Blue Mountains - Shoalhaven Hanging Swamps (FRW p130). These units tend to intergrade on the Woronora Plateau.”

The listing does not specifically exclude FRW p129. In fact, Wingecarribee Swamp is specifically included in the scope of THPSS in the listing. About 50 ha or 17% of this swamp has been mapped as FRW p129 by Tozer *et al* (2006). Similarly, about 80% of Butlers Swamp has been mapped as FRW p129. This suggests that swamps mapped as FRW p129 can be included as THPSS. The swamps mentioned in the listing encompass four vegetation types from Tozer et al (2006), two of which have already been mentioned (FRW p129 & FRW p130). The two remaining vegetation types are FRW p57 Tableland Swamp Meadow (including most of Wingecarribee Swamp) and FRW e59 Southeast Sub-alpine Bog (including Jacksons Bog). Reference to the dendrogram in Tozer et al. (2006) demonstrates that the floristic differences between FRW p130 and FRW p129 on the Woronora Plateau are subtle relative to the variation in floristics encompassed by the four vegetation types encompassing the swamps mentioned in the THPSS listing. FRW p129 and FRW p130 are clustered as sister groups in this dendrogram, while FRW p57 and FRW e59 are in a separate group of swamps. This suggests that if THPSS includes the group of vegetation types FRW p130, FRW p57 and FRW e59, then FRW p129 would logically be included in this group.

All of the fauna species mentioned in the listing have been recorded on the Woronora Plateau, with most being commonly observed. This includes both the Brown Antechinus which is more common and the Dusky Antechinus which is rarer. Both species of Leaf Green Tree Frog (*Litoria phyllochroa* and *Litoria nudidigita*) are also present. The Highlands Copperhead (*Austrelaps ramsayi*) is only present in the higher parts of the plateau, in the headwaters of the Nepean River.

Functionality, threats & integrity

Upland swamps are naturally fragmented because they are usually associated with valley headwaters with at least periodically waterlogged soils. The suitable geomorphological and climatic conditions for swamps are localized among a more extensive matrix of well drained soil types.

The threats to THPSS discussed in the listing include impoundment under water storages, peat mining, drainage for agriculture, fire (consumption of peaty substrate), subsidence associated with longwall mining, water extraction, weed invasion, changes in swamp hydrology, sedimentation and climate change. Stockyard and North Pole Swamps on the Woronora Plateau swamps are mentioned as possibly being impacted by longwall mining. Of the threats covered in the listing, the Woronora Plateau swamps are primarily threatened by changes in swamp hydrology associated with cracking of rock strata following subsidence (eg Flat Rock Swamp, Swamps 18 & 19 in Native Dog Creek). Fire also poses a threat to Woronora Plateau swamps. A smaller number are threatened with sedimentation associated with clearing (eg Dahlia Swamp).

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