Integrated Mining Policy:
Swamp Offset Policy
NSW Minerals Council Submission

NSW MINERALS COUNCIL

July 2015

Executive summary

The NSWMC welcomes the Government's move to establish a policy on offsets for the impacts of longwall mining on upland swamps. The policy aims to address an existing policy gap that has led to uncertainty in the assessment of underground mining projects in the Southern and Western coalfields. However, the policy as it stands will not work in practice and does not reflect the current scientific understanding about the impacts of longwall mining on upland swamps. It also creates unintended detrimental consequences for the mining industry as it drives significant offset ratios that could create liabilities for individual mines ranging from around $10 million up to potentially as much as $190 million. This would render many mining operations economically unfeasible, leading to job losses and increased unemployment, loss of potential government revenue from royalties, taxes and levies and socio-economic issues for communities that are dependent on mining.

The draft policy presents an overly simplistic framework to calculate and secure offsets that will result in unworkable offset requirements

The Government has attempted to develop a simple framework for swamp offsets to overcome issues associated with the uncertainty about the actual impact of longwall mining on swamps; the extended period before ecological impacts can be detected; and to facilitate faster offset negotiations with a certain endpoint.

While the attraction of a simple process is understood, the industry believes that the draft proposal is too simplistic, does not acknowledge the substantial body of knowledge that has been acquired about swamp impacts (which will continue to increase substantially in coming years), and will result in unworkable offset requirements.

As it stands, the draft policy will result in a significant (16:1) offset ratio, which is not justified by scientific evidence, and will not be able to be found in practice. This will result in a per hectare costs of up to around $2.5 million per hectare of upland swamp.

Evidence shows that mining often has no detectable impact upon the ecosystem function of swamps, yet the draft policy assumes that a change to hydrology will result in the complete loss of ecological function

Of primary concern for the industry is the sole focus on hydrology as an indicator of swamp impacts and the assumption that any impact that exceeds a 'negligible' impact on hydrology results in a complete loss of ecological value - a worst case scenario equivalent to clearing and excavating the swamp.

These fundamental aspects of the policy are not supported by existing long term monitoring of swamps both impacted by mining and not impacted by mining, and the wide range in swamp characteristics and hydrology.

There have been thousands of swamps that have been undermined with no detectable impacts. Those that have been impacted have also been subject to other secondary factors such as fire and heavy rainfall, clearing and water discharge, or climatic variations. It is difficult to separate mining induced effects from these other effects; however there is no evidence of a direct causal link between mine subsidence and swamp impacts.

When impacts have been identified, except in the rare and limited extent of swamp scouring, they have been limited to changes in vegetation composition rather than complete loss of ecological value.

The requirement to finalise offsetting arrangements within a five year window does not take advantage of the long term monitoring proponents undertake during the life of a project, or the prospects of rehabilitating impacts

While the draft policy's objective of finalising offset arrangements within a five year window may appear attractive, it discounts the value of the ongoing monitoring and research the industry conducts into swamp impacts throughout the life of a mining project. It is also inconsistent with offset and rehabilitation arrangements for open cut mines.

The industry believes that mechanisms for using the results of ongoing monitoring and swamp rehabilitation efforts beyond the five year window need to be incorporated into the policy, with the ability for subsequent reconciliation of offset liabilities based on the results.

The application of the policy to current assessments and existing approved projects is unacceptable

The transitional arrangements associated with the policy are very concerning. The application of the policy to projects that are at late stages of the assessment process is inappropriate when significant business decisions have been made based on existing arrangements. Retrospective application of legislative and policy instruments is by convention avoided except in very limited circumstances and should only be considered as a last resort.

The proposal to apply the policy to projects for any Extraction Plan approvals following 31 October 2015 is similarly concerning, particularly when existing performance criteria do not align with the triggers in the draft policy.

NSWMC strongly recommends that the application of the policy is restricted to applications made after the policy is finalised. For these projects, there may still need to be some flexibility around the timeframes within which offsets need to be secured.

Consistency with Commonwealth offset requirements is critical

It is critical that the NSW Government policy aligns with the Commonwealth position on swamp offsets. Unless the two levels of Government have policies that align, the benefits that the policy may have had in terms of increased certainty will not be realised.

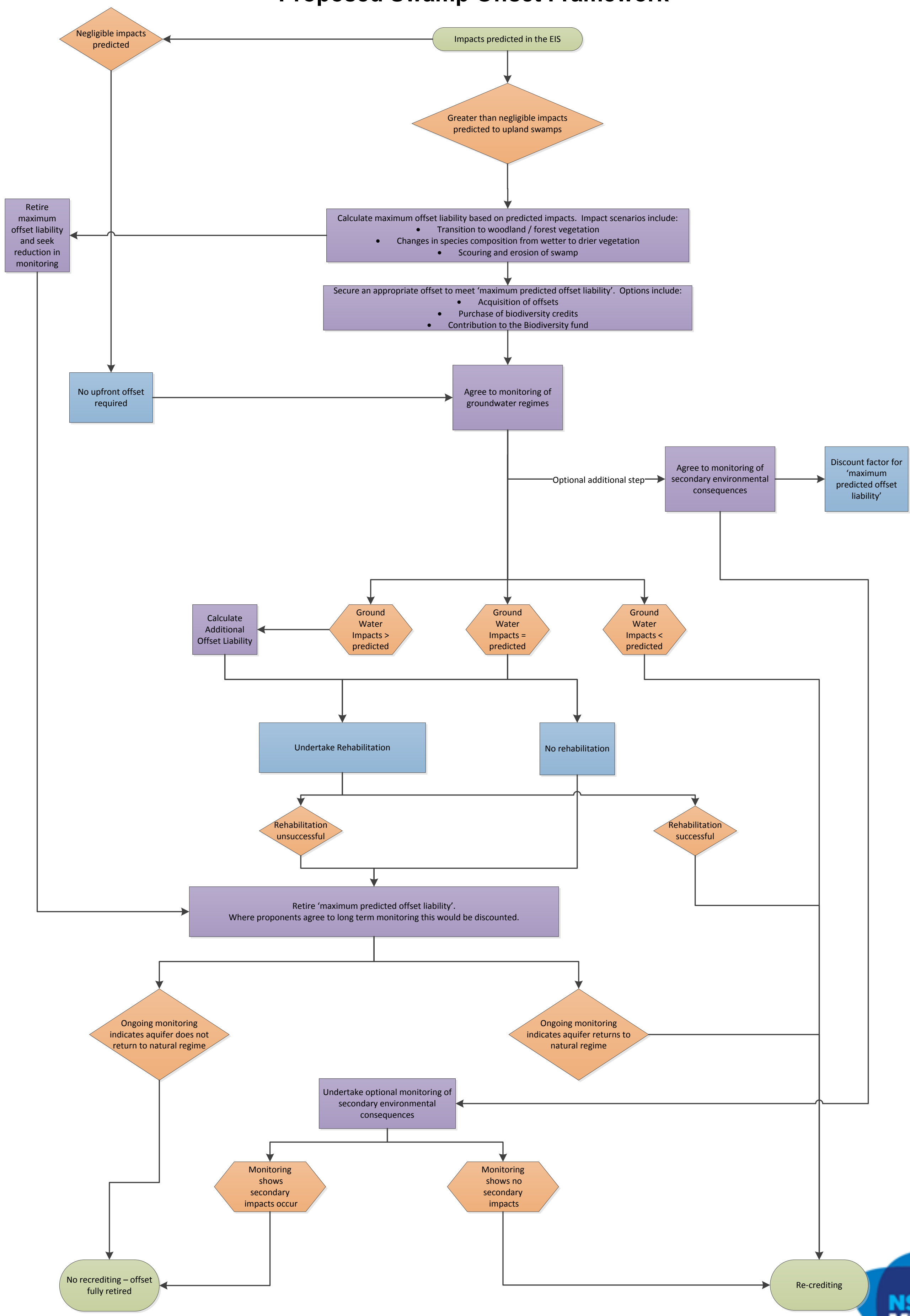
The industry recommends a more sophisticated model is implemented that acknowledges impacts are likely to be partial and includes a mechanism to utilise long term monitoring and rehabilitation

NSWMC has prepared a suggested framework for swamp offsets, which is outlined in the flowchart below. The key aspects of the framework include:

- A more sophisticated assessment of existing swamp characteristics (e.g. ecology and hydrology).
- A more sophisticated assessment of the likely change in ecology (e.g. based on a 'worst case' scenario of transition to forest/woodland and a more realistic change from a permanently waterlogged swamp to a periodically waterlogged swamp).
- A calculation of maximum predicted offset liability based on this partial impact using a revised methodology for use with the *Framework for Biodiversity Assessment* (OEH 2014b). This is included in Attachment 2.
- Options for proponents to either retire this maximum predicted offset liability and negotiate reduced monitoring requirements, or alternatively commit to ongoing monitoring to measure actual impacts to swamp ecology and reconcile the maximum offset liability based on the results.
- Mechanisms for indirect offsets (e.g. trust fund payments) to address the lack of swamp offsets available on privately owned land in some regions.

DPE should also be aware that there is a common, yet inaccurate assertion that upland swamps provide significant base flow to Sydney's water catchment. In May 2014, the NSW Chief Scientist commented that "Swamps in the Catchment act like sponges, storing surface water and in some cases accessing groundwater storage to contribute to base flow. In times of drought, they are critical in maintaining stream flow." The assumption that all upland swamps provide a significant contribution to base flow is not supported by available data because not all upland swamps provide a contribution to base flow. Despite this supposition, the NSW Chief Scientist (2014) concluded that "the current [cumulative] impacts [including potential impacts to swamps] are **not seeming to affect water quantity [in the Sydney Catchment] in a major way.**"

Proposed Swamp Offset Framework



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About the NSW Minerals Council

The NSW Minerals Council (NSWMC) is the peak industry association representing the NSW minerals industry. Our membership includes around 100 members, ranging from junior exploration companies to international mining companies, as well as associated service providers.

Introduction

The NSW Minerals Council (NSWMC) welcomes the opportunity to comment on the *Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species* (Swamp Offset Policy). The *Swamp Offset Policy* is an important means of compensating for impacts to upland swamps.

The release of the *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014a) (Biodiversity Offsets Policy), and associated *Framework for Biodiversity Assessment* (OEH 2014b) (FBA) has gone some way towards providing clarification on the offset requirements for major mining projects in NSW. However, the *Biodiversity Offsets Policy* does not provide guidance on impacts that are "*not associated with clearing of vegetation*", including "*subsidence and cliff falls* [from] *mining developments*".

To date, impacts to upland swamps have been dealt with on a project-by-project basis, with outcomes negotiated between the proponent, the Office of Environment and Heritage (OEH) and the Department of Planning and Environment (DPE). The lack of a framework in which impacts to upland swamps are assessed has resulted in a lack of certainty for proponents and regulators, limitations to biodiversity offset arrangements including a lack of flexibility, and has often led to protracted negotiations around approvals.

The *Swamp Offset Policy* seeks to close this policy gap by providing a framework for offsetting potential impacts arising from longwall coal mining on upland swamps, and seeks to align this with the *Biodiversity Offsets Policy*.

The NSWMC acknowledges and welcomes DPE and OEH's commitment to addressing this gap in policy and believes there are a number of positive elements that the NSWMC finds encouraging. However, in its current form, the *Swamp Offset Policy* is likely to lead to perverse and likely unintended outcomes. There are a number of positive elements, within the *Swamp Offset Policy that* NSWMC finds encouraging. Some of these positive elements require some refinement prior to implementation. Nevertheless, positive elements include:

- No upfront offset is required where 'nil' or 'negligible' impacts to upland swamps and threatened species are predicted.
- The Policy represents an opportunity to provide certainty to industry by clearly defining when offsets would be required and the framework under which offsets are calculated and delivered.
- Allowing for uncertainty in predicting impacts to upland swamps by providing mechanisms for predicted and unpredicted impacts.
- Acknowledgement that only part of a community may be affected by subsidence related impacts.
- Recognition of the complex relationship between actual (and potential) subsidence related impacts and endangered ecological communities.
- The timeframe for monitoring of upland swamps following mining being limited to 12 months.

- The timing with regards to the provision of offsets, allowing six months for offsets to be retired once an impact is defined.
- Allowing for re-crediting of retired offsets.
- Allowance for proponents to acquit the full value of the offset and negotiate for a reduction in ongoing monitoring requirements.

Notwithstanding these positives, there are a number of issues that require resolution prior to implementation. Overall, in its current form, the *Swamp Offset Policy* is simplistic, unworkable, overly conservative and not evidence based in its assumption regarding impacts. Given the body of evidence indicating that there is no direct causal link between subsidence associated with longwall mining and impacts to upland swamps, the extent of mining beneath upland swamps in both the Southern and Western Coalfield and the limited number of impacts observed to date (refer to literature review in Attachment 1), NSWMC considers that the *Swamp Offset Policy* requires significant revision prior to implementation. This submission proposes a number of revisions that will make the *Swamp Offset Policy* workable, flexible whilst providing certainty to industry, community and government. Key issues include:

- The definition of 'nil' or 'negligible' environmental consequences.
- A lack of consideration of secondary environmental consequences in calculation of the offset liability and in re-crediting of offsets.
- A lack of consideration of remediation as a mechanism for provision of offsets.
- The use of "loss" to calculate 'maximum predicted offset liability'.
- The perverse offset requirements, including offset ratios and costs, arising from the use of the calculator associated with the FBA.
- Scarcity of offsets, due to swamp communities being well conserved in National Parks and Crown Land.
- The relationship of this Policy with the Commonwealth's EPBC Act Offset Policy and the Bilateral Agreement.

Each of the issues is discussed below, along with NSWMC's recommendations.

Issues

1. The definition of 'nil' or 'negligible' environmental consequences is inappropriate, unfair, often unachievable and unworkable.

The *Swamp Offset Policy* requires an offset as a condition of consent when an upland swamp is likely to experience greater than 'nil' or 'negligible' consequences. The definition of a 'nil' or 'negligible' environmental consequence is defined in the policy as subsidence that will not result in "*changes to shallow groundwater regimes supporting an upland swamp community*".

The use of the shallow groundwater regime as the sole determinant of 'nil' or 'negligible' environmental consequences is unnecessarily precautionary, and does not take into consideration the number and extent of upland swamps that have been mined beneath over the past century and a half. Defining environmental consequences in terms of "*changes to shallow groundwater regimes"* is inappropriate, unfair, often unachievable and unworkable because:

- 'Changes' to shallow groundwater regimes are likely to be experienced even in upland swamps that do not experience any subsidence.

- 'Changes' to the shallow groundwater regime may not be caused by subsidence. The changes may have occurred as a result of weather and climatic events, such as drought, bushfires and heavy rainfall, or natural geological activity (such as earthquake) or other anthropogenic influences (such as water supply infrastructure).
- 'Changes' may not result in any negative secondary environmental consequences to an upland swamp ecological community, or the threatened species that inhabit an upland swamp.

The definition of 'nil' or 'negligible' must also remove the assumption that there is a direct causal relationship between subsidence and the catastrophic impacts or loss of upland swamps. Attachment 1 provides a review of currently available data on the impacts to upland swamps in the Western and Southern Coalfield. This review indicates that secondary factors have been implicated in identified impacts to upland swamps, and that most impacts are restricted to transition from wetter to drier swamp flora species, with some scouring in a limited number of cases. The definition of 'nil' or 'negligible' does not take this into consideration, and assumes that any impact to the perched aquifer associated with an upland swamp will result in the loss of the upland swamp.

Recommendations

- Redefine 'nil' or 'negligible' environmental consequences to reflect impacts to a swamp that have been caused by mining-induced subsidence by incorporating BACI monitoring design principles, and the use of reference site(s), into the definition to separate natural and mine-induced impacts.
- Redefine 'nil' or 'negligible' environmental consequences to recognise the potential for varying degrees of secondary environmental consequences depending on the hydrological conditions and character of a swamp. This can be achieved by incorporating a measure of hydrological character into the definition, e.g. *changes to shallow groundwater regimes supporting <u>vegetation communities reliant on significant groundwater resources within</u> an upland swamp community*".
- Include the following in the definition of negligible:
  - Greater than negligible erosion of the surface of the swamp; or,
  - Greater than negligible changes in the size of the swamp; or,
  - Greater than negligible changes in the ecosystem functionality of the swamp; or,
  - Greater than negligible change to the composition or distribution of species within the swamp; or
  - Greater than negligible change to the structural integrity of any controlling rockbar/s for the swamp.

2. The *Swamp Offset Policy* does not recognise the important role of long term monitoring of secondary environmental consequences, nor consider the potential for successes of remediation or rehabilitation measures, as well as natural processes of regeneration

The *Swamp Offset Policy* does not acknowledge the role long term monitoring can play in improving our understanding of the timing and extent of secondary environmental consequences arising from subsidence. Over a number of years industry has invested in this field, improving our understanding of the interaction between upland swamps, geology, groundwater and upland swamps. Given this, the Policy should be revised to incorporate and encourage a sensible monitoring program that incorporates not only the secondary environmental consequences arising from subsidence but also the use of contemporary and emerging data capture and management technologies, such as Light Detection and Ranging (LiDAR) data, as well as multi-spectral data and indices such as Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) which will allow for monitoring of the condition of vegetation in upland swamps.

In circumstances where proponents wish to undertake long-term monitoring, the 'maximum predicted offset liability' would be discounted in recognition that monitoring advances our understanding of the timing and extent of secondary environmental consequences arising from subsidence. If impacts from subsidence to groundwater regimes occur, retirement of the 'maximum predicted offset liability' would be required. In circumstances where secondary environmental consequences do not result, as illustrated by long term monitoring undertaken in excess of five years, recrediting of the future offset liability could be achieved by discounting any future offset liability.

Remediation or rehabilitation measures have been implemented at a number of locations in both the Southern and Western Coalfields. Although success is not guaranteed, there have been several examples of successful outcomes. Two case studies are presented below.

Case Study 1 – Remediation of East Wolgan Swamp (Centennial Coal)

Centennial Coal has recently undertaken rehabilitation of the East Wolgan Swamp located above the Springvale Colliery Remediation works for East Wolgan Swamp incorporated the remediation methodology developed by the Save Our Swamps Program and included the development of a monitoring plan designed to measure the success of restoration actions, integrity of engineering structures, vegetation monitoring, and water and soil moisture monitoring. Rehabilitation methods included the following:

- Excavation, examination of bedrock cracking and piping within the swamp sediments and implementation of an approved plan (developed in consultation with OEH representatives) for sealing cracked bedrock and piping. Sealing of preferential flow paths caused by bedrock cracking and extensive piping within the swamp sediments was conducted using bentonite (a naturally occurring clay material which is often used for that application in dam repairs and other civil works).
- Excavation of peat / soil and filling of areas affected by erosional slumping. Coir logs laid in the excavated areas level, with sand used to pack voids and cover logs. Retention and placement of the upper peat / soil (containing the native seed bank and vegetative propagules) in its correct profile. Jute mesh was placed over the top to create shade and retain moisture to encourage plant growth
- Brush matting of area to prevent some of the animal grazing on regenerating plants (which is apparent throughout the area is a factor impeding the natural regeneration of the swamp).
- Use of level spreader structures in the deeper areas of channelisation present in the swamp to spread some of the surface flows out over the swamp rather than concentrated flows.
- Direct seeding of the areas surrounding the slumping sites using seed collected from the adjoining swamp vegetation. The natural regeneration of the swamp vegetation is being monitored to assess the need if any for supplementary planting of indigenous species.
- A regular weed control program has been implemented to monitor the establishment of both annual and perennial weed establishment and control these where they are hindering the regeneration processes.

The remediation program for East Wolgan Swamp was supervised by officers from the Office of Environment and Heritage and the rehabilitation activities were reviewed by members of the International Mire Conservation Group. These works have demonstrated an ability to sensitively remediate not only the surface integrity of an impacted swamp (regardless of the impact), but also sub-surface and bedrock impacts through the application of bentonite.

Case Study 2 - Waratah Rivulet Rock Bar Remediation (Peabody Energy)

Peabody Energy's Metropolitan Coal has operated within the NSW southern coalfields for over 126 years. Longwall mining methods have been utilised since 1995 to produce approximately 2 million tonnes of metallurgical coal per annum. Subsidence impacts associated with longwall extraction have resulted in a loss of surface flow and pool holding capacity along sections of the Waratah Rivulet within the Woronora Special Area. New remediation technologies have been developed to restore stream function.

The Metropolitan Coal rockbar remediation process has utilised polyurethane resin (PUR) injections to restore surface flow to the Waratah Rivulet. PUR is injected via a series of preselected drill holes to effectively create an impermeable subsurface grout curtain at the downstream end of the affected pool. Water is forced back to the surface when it encounters the low permeability of the grout curtain, restoring pool water holding capacity and stream flow. Metropolitan Coal has implemented this technology for the remediation of two pools, identified as WRS3 and WRS4. Monitoring continues at these locations, with strong evidence that water holding capacity and surface flow has been restored.

It is believed that PUR grout technology could be applied to the remediation of swamps impacted by subsidence, in particular repairing subsurface fracturing of underlying sandstone in addition to sealing surface fracture networks. Whilst this technology has yet to be implemented to remediate a swamp, the fundamental principle of creating an impermeable barrier or basin is similar as in the remediation of a watercourse. In order to create a basin, PUR could be applied in a number of ways depending on the extent and nature of the fracture network as well as the swamp; this could include both vertical and horizontal drilling and subsequent injections.

These case studies provide important examples of how remediation and rehabilitation may be used to reverse impacts to upland swamps or stream systems. Rehabilitation of either identified impacts or previously impacted upland swamps (including those currently located on Crown Land) should be identified within the *Swamp Offset Policy* as an option for industry if subsidence impacts are greater than predicted, and should be offered if an offset is not available. The choice between rehabilitation of an impacted swamp or retiring of credits must be able to be at the discretion of the proponent, as the decision will largely be driven by an adequate business case.

The NSWMC has developed a flexible and adaptive offset model that provides flexibility as well as certainty for industry, community and government through a solutions oriented approach. This framework (see Executive Summary) includes the following key aspects:

- Requires the prediction of impacts upfront.
- Requires the calculation and securing of an appropriate offset to meet the 'maximum predicted offset liability'.
- Allows flexibility for industry by allowing proponents to:
  - Acquit the full value of their offset liability and reduce monitoring requirements.
  - Agree to long-term monitoring of secondary environmental consequences and receive a discount on their offset liability, encouraging industry to further our understanding of the timing and extent of secondary environmental consequences.
- Undertake monitoring of groundwater regimes, only.
- Allows for industry to attempt rehabilitation where impact occurs.

This model allows for recrediting of offsets if impacts are less than predicted, rehabilitation is successful or long term monitoring of secondary environmental consequences shows secondary impacts have not occurred.

Recommendation

- Implement the swamp offset framework set out in the Executive Summary.
- Amend the *Swamp Offset Policy* to encourage proponents to undertake monitoring of secondary environmental consequences by discounting the upfront credit liability and allowing for re-crediting of retired or deposited offset should long-term monitoring indicate secondary environmental consequences do not arise.
- Amend the *Swamp Offset Policy* to allow for the potential for remediation and rehabilitation of upland swamps, including upland swamps previously impacted on Crown Land, prior to retirement of credits.
- Provide a mechanism for re-crediting of offsets if secondary environmental consequences do not occur or rehabilitation is successful.

3. Calculation of the 'maximum predicted offset liability' as defined by the *Swamp Offset Policy* is unreasonable, and is contrary to the *Biodiversity Offsets Policy*

Despite the uncertainty in the prediction of subsidence and consequent environmental outcomes for upland swamps, the *Swamp Offset Policy* requires proponents to calculate the 'maximum predicted offset liability' (i.e. worst case scenario), . The 'worst case scenario' is calculated for the total area of upland swamp predicted to be subject to greater than negligible environmental consequences, and is calculated as "*the ecosystem credits equivalent to the predicted loss of the upland swamp vegetation types*".

It is not appropriate to assume complete loss as there are no examples of subsidence impacts to swamps resulting in complete loss of an upland swamp. The review of past impacts to upland swamps from subsidence (Attachment 1) identified that there is no direct causal link between subsidence associated with longwall mining and impacts to upland swamps, with secondary factors implicated in identified impacts to upland swamps. UQ (2015) identified that where subsidence impacts do occur this may result in flora species composition change but the swamp community would remain within the upland swamp classification. These examples provide a sound basis for an alternative methodology for the calculation of offsets, which could be used to calculate a realistic 'worst case scenario, as well as a scenario where only 'partial impacts' occur.

Calculation of an offset liability using the FBA calculator was undertaken (Attachment 2) using a variety of modelling scenarios including:

- Complete loss of upland swamp vegetation, as outlined in the *Swamp Offset Policy.*
- Transition from upland swamp vegetation to woodland/forest communities.
- Transition of vegetation from wetter swamp types to drier swamp types.

The methodology for these calculations is presented in Attachment 2. The assumption of loss to calculate the 'maximum predicted offset liability' will result in the highest offset ratios of any major project in NSW, with offset requirements of up to 80 credits per hectare for vegetation in benchmark condition and 40 credits per hectare based on data collected for a limited subset of swamps. Offset sites will provide as few as 5 to 6 credits per hectare due to minimal management gains. This will result in offset ratios of 16:1, some of the highest offset ratios for major projects in NSW. Based on a review of current credit costs, offsets of this magnitude may cost up to $2,517,200 per hectare of upland swamp, with costs ranging from $587,760 to $1,288,880 based on other estimates.

Changes to upland swamps resulting from subsidence are, at worst, more likely to include transition to drier woodland/forest communities (Biosis 2015). Therefore, a more appropriate definition of 'maximum offset liability' would be ‘transition to woodland / forest vegetation’, rather than "loss". Using this scenario would require offsets of 5 to 11 credits per hectare. These values represent a much more realistic estimate of the 'worst case' scenario, and provide a realistic estimate on which the 'maximum offset liability' can be calculated. Using values associated with a transition from wetter to drier swamp types credit requirements drop to 5 to 8 credits per hectare; this would be akin to partial impact.

The assumption of complete loss is not appropriate for determining the 'maximum predicted offset liability'. Attachment 2 provides an alternative methodology for using the FBA calculator to determine the 'maximum offset liability' based on a realistic 'worst case' scenario of transition to woodland/forest vegetation. NSWMC stresses that based on a review of available data this provides an extremely conservative assessment of actual impact, and an assumption of transition from wetter to drier swamp communities is in some cases a more realistic assumption. The methodology outlined in Attachment 2 shows how this can also be achieved using the FBA calculator.

Recommendations

- Remove the assumption of complete loss from the methodology for calculating the ‘maximum offset liability'.
- Revise the methodology for calculating 'maximum offset liability' to accurately reflect the 'worst case scenario' for changes in vegetation condition in upland swamp arising from subsidence. This would be calculated as a transition to woodland/forest vegetation using the methodology outlined in Attachment 2.
- Allow for the calculation of partial impacts using the alternative methodology outlined Attachment 2, assuming transition from wetter to drier swamps types.

4. Securing an appropriated offset for predicted impacts prior to approval of an Extraction Plan is impractical, particularly for existing projects

The *Swamp Offset Policy* requires proponents to demonstrate "*how it will fully meet the requirements of its 'maximum predicted offset liability*'" and how it will "*legally secure the proposed offsets*", either through purchase of an appropriate site, purchase of credits, provision of a bond or deposit or other supplementary measures. This must be undertaken "*prior to approval of an Extraction Plan*".

In the Southern Coalfield (Planning Assessment Commission 2015) most of the Coastal Upland Swamp communities are located on Crown lands such as National Parks or other reserves, or on land managed by Water NSW (NSW Scientific Committee 2012); very few upland swamps are located on private land that could be secured through an offset. This lack of availability does not reflect the conservation status of the community, rather is indicative of a high degree of protection within the reserve system. The consequence of this lack of availability will be high per unit costs for credits, as outlined above.

Currently, there are no upland swamp credits available in the market, resulting in the need for companies to acquire land. Potential offset areas on private lands within the Western and Southern Coalfields are disparate small areas, making offsetting more complex. The use of these disparate, small areas as offsets would require the subdivision of small parcels to meet offset requirements (Illawarra Coal 2015). This acquisition of disparate parcels of land to fulfil offset requirements does not provide a strategic approach to the provision of offsets (DPE 2015) – it is an artificial process, splits land arbitrarily and prevents the provision of strategic offsets that may provide greater biological benefits to NSW. It is acknowledged that "*a more strategic approach to the provision of offsets*" is required (OEH in DPE 2015).

The Trust Fund associated with the *Biodiversity Offsets Policy* would provide this strategic approach. In line with the *Swamp Offset Policy*, a "*security bond or deposit*" could be paid into the fund to allow the strategic acquisition of offsets for predicted impacts to upland swamps. However, to provide increased certainty, the current definition of the 'maximum predicted offset liability' should be refined. This is due to the prohibitive costs associated with the current definition, and that any security bond or deposit to the Trust Fund would be refundable under the same terms as re-crediting of retired or deposited offsets as currently outlined within the *Swamp Offset Policy*.

Recommendations

- The requirement for provision of offsets upfront, including payment into the Biodiversity Offsets Policy Trust Fund, must be removed. Payment should be contingent on impacts being detected by monitoring.
- The *Swamp Offset Policy* must make use of the Biodiversity Offsets Policy Trust Fund to secure offsets in a strategic manner is the most appropriate mechanism for securing an offset.

5. The retrospective application of the *Swamp Offset Policy* to previously approved projects or projects which have come off public exhibition is unacceptable

The *Swamp Offset Policy* will be applied to mines that "*have existing development consent for longwall mining that may cause subsidence impacts on upland swamps*", with the policy to be applied to all new "*Extraction Plans approved following 31 October 2015*". Retrospective operation of policy is very undesirable on public policy grounds and should only be considered in extremely limited circumstances. Retrospective application of the *Swamp Offset Policy* creates uncertainty for proponents that have an approval, or one pending, and will require significant additional work prior to approval, resulting in significant and unreasonable delays and costs. The available evidence does not support the need for retrospective application in these circumstances.

Acquiring suitable offsets is often a long, drawn out process, exacerbated in this case by the very limited availability of offset land. An offset site requires assessment of vegetation and credit availability, registration of the site under an appropriate mechanism and then retiring of credits. For projects being currently assessed, including Centennial Coal's Springvale Mine Extension Project and Wollongong Coal's Underground Expansion Project, securing offsets prior to approval of an Extraction Plan is unachievable.

For example, the draft *Swamp Offset Policy* was released around two years after the DGRs for the Centennial Coal's Springvale Mine Extension Project were issued and 12 months after the EIS came off exhibition, and more than five years after DGRs were issued for Wollongong Coal's Underground Expansion project and more than two years after the EIS was exhibited. It is inappropriate to retrospectively apply a new calculation tool where significant business decisions have already been taken based on the policy of the day. Appropriately defined transitional arrangements must therefore be in place for the implementation of this Policy.

It also means that these projects that do not have two years of baseline monitoring for all upland swamps within 400 metres would not be able to seek a reduction in their 'maximum offset liability'.

Recommendations

- Amend the *Swamp Offset Policy* to remove its retrospective application to previously approved projects and projects that are now before the Planning Assessment Commission for determination. The Policy should only apply to applications made after Cabinet approves the policy.
- If this is not possible, the Department must allow flexibility during the transitional implementation of the *Swamp Offset Policy*, particularly in relation to the requirement to secure an offset prior to the approval of an Extraction Plan for projects currently being reviewed by the Planning Assessment Commission.
- For mines with existing development consents for longwall mining, but that have not had any requirement to monitor groundwater in surrounding swamps, applications should be extended beyond 31 October 2015 to a point in time where a proponent will have had the opportunity to obtain two years of pre-mining data, i.e. August 2017.

6. The *Swamp Offset Policy* does not allow for the contribution to supplementary offsets such as improvement to upland swamps on Crown Land

The inescapable reality is that not many like-for-like offsets sites will be available, as most are already protected in some manner (e.g. on existing reserves). Supplementary offset measures must therefore be allowed for.

To date, a very limited number of impacts to upland swamps have occurred. These upland swamps are largely located on Crown Land. As outlined above, there are several examples of successful outcomes from remediation and rehabilitation.

The *Biodiversity Offsets Policy* identifies a number of supplementary measures that can be used to offset impacts. The rehabilitation of previously impacted upland swamps would provide an action directly related to the entity impacted, by providing positive biodiversity outcomes for upland swamps. This would align with a Tier 1 supplementary measure, as outlined in OEH (2014a).

The *Swamp Offset Policy* should include rehabilitation of previously impacted upland swamps as an alternative method to like-for-like offsets for securing an appropriate offset. Tier 1 supplementary measures can be used to fulfil the offset requirement for species and communities listed under the EPBC Act, ensuring alignment with the EPBC Act *Environmental Offset Policy* (Commonwealth of Australia 2012).

The insistence by the Commonwealth Government on limiting supplementary measures to Tier 1 (like-for-like) measures is a rigid approach to compensating biodiversity impacts that is not only impractical, but ignores the fact that valuable biodiversity outcomes can be achieved through the conservation of upland swamps in existing reserve areas and contributions to broader conservation initiatives (i.e. Tier

2-4 measures). This is particularly the case where the impacts are indirect (e.g. subsidence). These should be considered and negotiated by DPE and OEH with the Commonwealth Government.

Recommendation

- Include rehabilitation of previously impacted upland swamps as an alternative to like-for-like offsets when securing an appropriate offset.
- In defining appropriate supplementary measures for swamp offset impacts, allow for the conservation of upland swamps in existing reserve areas as well as contributions to broader conservation initiatives.

7. The FBA needs to be aligned with the EPBC Act Offset Policy

The majority of mining projects in the Western and Southern Coalfield will require referral to the Commonwealth Department of the Environment for assessment due to the presence of listed threatened species and ecological communities and a water resource, in relation to coal seam gas development and large coal mining development. Under the EPBC Act *Environmental Offsets Policy* (Commonwealth of Australia 2012), 90 per cent of the offsets required must be provided by a direct offset.

The NSW and Commonwealth governments have both stated intent to reduce green tape in the assessment of major projects. Given this, the NSWMC encourages DPE to consult extensively with the Department of the Environment and ensure alignment with the EPBC Act *Environmental Offsets Policy* (Commonwealth of Australia 2012). This submission provides a number of methods in which this can be achieved.

Recommendation

- Ensure the *Swamp Offset Policy* is aligned with the EPBC Act *Environmental Offsets Policy*, by ensuring rehabilitation of previously impacted upland swamps is included as a Tier 1 supplementary measure, thus fulfilling the requirement of direct offsets under the EPBC Act.

8. There are a number of aspects of the *Swamp Offset Policy* which require further definition and detail

There are a number of additional items within the *Swamp Offset Policy* that require further consideration. These are outlined below:

- The *Swamp Offset Policy* does not currently define an "upland swamp" and which communities are covered by the policy. The *Swamp Offset Policy* currently refers to "upland swamps" which would include the Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion and the Coastal Upland Swamp in the Sydney Basin Bioregion. It is unclear whether the Blue Mountains Swamps in the Sydney Basin Bioregion community are excluded from the operation of the policy. In addition, the relationship of these swamps to Commonwealth listing is unclear.
- The Policy states that "*If monitoring shows that mining has significantly impacted the shallow groundwater aquifer in a swamp . . . then an offset must be identified and secured within 6*

months of the completion of that period". A definition of 'significant' is not provided. Significant should be defined as impact that indicates a long term change in swamp hydrology, water quality or floristic composition, greater than recorded in reference sites during the same period.

- The use of the FBA is required to calculate offset requirements. The FBA calculator assumes clearing of vegetation and associated threatened species habitat. The 'associated threatened species' is not defined. Use of the FBA calculator will require credits for a number of species that would not be impacted. Associated threatened species must be restricted to groundwater dependant species only.
- Under the policy, prediction of impacts to the shallow groundwater system associated with upland swamps is required. However, the policy does not define whose predictions the government will rely upon. Given the requirement within the policy for offsetting of unpredicted impacts, which allows for the uncertainty in the "*prediction of subsidence and consequent environmental outcomes for upland swamps*", this should be clearly defined to include predictions of impacts to upland swamps, *as outlined within the Environmental Impact Statement*.
- The current *Swamp Offset Policy* requires monitoring of the hydrology of all upland swamps within 400 metres of the longwalls. This is a very simplistic definition of the potential extent of impacts, and does not take into consideration depth of cover, underlying geology etc., and may result in an excessive level of monitoring. The *Swamp Offset Policy* should be refined to require monitoring of all upland swamps within the 20 millimetre subsidence contour.
- The NSWMC have made previous submissions on the FBA with respect to the vegetation community classifications and the underlying inadequacy of the relevant databases. Unless these are addressed, any tool used to calculate an offset requirement will be flawed and subjective. This issue is particularly relevant to the Western Coalfield and Centennial Coal's submission on the *Swamp Offset Policy* outlines the issue in further detail.

9. Arguments relating to the significance of upland swamps to Sydney's water catchment are unsubstantiated

There is a common assertion that upland swamps provide significant base flow to Sydney's water catchment, particularly during periods of low rainfall. In May 2014, the NSW Chief Scientist (2014), in its report entitled "*On measuring the cumulative impacts of activities which impact ground and surface water in the Sydney Water Catchment*", commented that "Swamps in the Catchment act like sponges, storing surface water and in some cases accessing groundwater storage to contribute to base flow. In times of drought, they are critical in maintaining stream flow." The application of such a broad principle to represent a complex system such as upland swamps is simplistic and is not warranted. For example, flow data from the wettest upland swamp within Wollongong Coal's Underground Expansion Project shows that flow from this swamp ceases after a very short period. This swamp provided measurable flow for just nine days after a significant rainfall event associated with an east coast low in April 2015. This data illustrates that not all upland swamps provide the contribution to base flow, as is commonly assumed. Despite this supposition, the NSW Chief Scientist (2014) also concluded that "the current [cumulative] impacts [including impacts to swamps] are not seeming to affect water quantity in a major way." The assumption that all upland swamps provide a significant contribution to base flow is not supported by available data.

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Attachment 1 - Literature Review of Potential Mining Related Impacts to Upland Swamps

Introduction

Although hypothesised to be a contributing factor, a direct causal link between subsidence and impacts to upland swamps has not been established. Mining related impacts to a limited number of upland swamps have been observed (EarthTech 2003, Tomkins and Humphrey 2006, DECC 2007, Commonwealth of Australia 2014a, Corbett et al. 2014a) and these reports included detailed analysis of the cause(s) of these impacts. These reports are reviewed below.

Review of Impacts to Upland Swamps

Swamp 18 – Southern Coalfield

Mining beneath Swamp 18 was undertaken between 1995 and 1997, with longwall mining perpendicular to the swamp. Cracking of soils was recorded within the swamp in late 2001, following mining. A high-intensity wildfire burnt through the swamp in December 2001. This fire event was followed by heavy rainfall of 158 millimetres between 4 and 6 February 2002, just 14 days after the wildfire. Following this, major gully erosion of this swamp, including scouring and erosion to bedrock and loss of a section of the swamp, was observed. Tompkins & Humphrey (2006) concludes that subsidence of 1.2 metres is likely to have resulted in dewatering of Swamp 18, increasing the susceptibility of this swamp to fire. Given this dewatering, it is likely that the intensity of the fire resulted in burning of the peat sediments within the swamp. It is likely that a combination of factors, including prior erosion, fire, anthropomorphic impacts and heavy rainfall breached some undefined thresholds. Dewatering and drying as a result of fracturing of the bedrock may have increased the susceptibility of Swamp 18 to erosion. Erosion scars within the swamp were noted prior to mining, and are likely to have increased the susceptibility of this swamp to erosion. The combination of factors, including past erosion, wildfire and heavy rainfall, contributed to this erosion event as illustrated by EarthTech (2003) and Tompkins & Humphrey (2006) who undertook an analysis of seven upland swamps where longwall mining has occurred. No other swamp was observed to have the same secondary impacts including erosion and gullying and loss of vegetation. For example, Swamp 19 has a similar mining history to Swamp 18, and was burnt during the 2001 wildfire. Cracking of bedrock has been observed below the swamp and in exposed bedrock within the swamp. Despite this, Swamp 19 has not seen any increased erosion.

Drillhole Swamp – Southern Coalfield

Drillhole Swamp has an extensive history of mining, including board and pillar mining, pillar extraction from 1965 to 1969 and longwall mining from 1975 to 1977. Cracking in the bedrock downstream of the swamp was observed in 1971 and was linked to subsidence. Investigation of the swamp by the Metropolitan Water, Sewerage and Drainage Board resulted in significant disturbance to surface of the swamp through construction of an access track and a small dam. A high rainfall event in 1978 caused the failure of this dam and triggered erosion (Tompkins & Humphrey 2006). Following erosion, several cracks were noted in the bedrock of the swamp (Commonwealth of Australia 2014a). No further erosion has resulted due to natural bedrock control (Commonwealth of Australia 2014a). Whilst mining may have resulted in fracturing of the bedrock beneath this swamp, the main erosion event has occurred due to the construction of the access track and dam, and breach of this dam following heavy rainfall in 1978.

Flatrock Swamp – Southern Coalfield

A high-intensity wildfire burnt through Flatrock Swamp in 2001. This was followed by mining beneath the swamp in 2002, with additional mining undertaken between 2005 and 2007. Cracks in the bedrock of Waratah Rivulet were observed in 2003; however, no cracking was observed within the swamp. Erosion of the surface of this swamp had started to occur prior to mining, with a number of scour pools evident as far back as 1947 (Tompkins & Humphrey 2006). Erosion of the main channel of the swamp was observed in February 2002, prior to the commencement of mining. Additional erosion and gullying of the upper section of the swamp was observed following mining, with development of knickpoints (sharp changes in slope) in the swamp. Whilst mining may be a contributing factor to additional erosion and gullying, it does not explain erosion of the lower section of the swamp prior to mining (Tompkins & Humphrey 2006).

East Wolgan Swamp – Newnes Plateau

Mining beneath East Wolgan Swamp occurred in March 2006. Groundwater levels were observed to decline in late 2006 (Commonwealth of Australia 2014a). Surface water discharge into the swamp commenced in 1997, with a site inspection in 2008 finding that mine water discharge was entering a cavity in the base of the swamp (Corbett et al. 2014). Further investigation indicated that mine water discharge has resulted in impacts to this swamp, including dieback of vegetation changes in soil water chemistry and swamp hydrology, erosion, elevated sediment loads, piping and slumping of peat and development of a cavity beneath the swamp (Corbett et al. 2014). Benson and Baird (2012) report death of moisture dependant species in the swamp. Analysis of piezometric data indicates that this swamp is highly influenced by discharge, with piezometer levels falling to basement levels when mine discharge was not occurring, indicating that this swamp is only periodically waterlogged prior to mining. No changes to water levels in the swamp have been observed (Corbett al. 2014). Goldney et al. (quoted in Corbett et al. 2014) attributed the observed impacts principally to mine water discharge, with the role of mining unable to be determined.

Narrow Swamp – Newnes Plateau

Mining beneath Narrow Swamp occurred between 2004 and 2010 (Corbett et al. 2014). Hydrograph analysis in Corbett et al (2014 indicates that the dominant influencing factor on measured water levels in Narrow Swamp is mine water discharge, with a reduction in flow and a decline in groundwater levels following cessation of emergency water discharge. Analysis of mine water discharge data by Corbett et al. (2014) indicates that there has been no change in the percentage of discharge water reaching flow monitoring stations in the middle and at the downstream extent of the swamp, indicating no significant cracking in the base of the swamp. Analysis of piezometer data indicates that the swamp was periodically waterlogged prior to mining. It remains periodically waterlogged following mining (Corbett et al. (2014) Mining beneath the swamp coincides with cessation of water discharge, explaining the reduction in flow observed by Muir (2010).).

Junction Swamp – Newnes Plateau

Junction Swamp was mined beneath between 2003 and 2004. Following mining there was a decline in outflow from this swamp, along with a decline in groundwater (Commonwealth of Australia 2014a). Corbett et al (2014) identified a very strong correlation between standing water levels beneath the swamp and the cumulative rainfall deviation for all swamp piezometers over the eleven years of monitoring at this location, and no evidence of groundwater level change in response to longwall mining at Junction Swamp. Corbett et al (2014) also identified that the erosional and flora impact effects described by Goldney et al (2010) are consistent with those observed prior to any mining being conducted at Junction Swamp (where a surface water monitoring weir was installed in a major erosional incision prior to longwall mining in the area).

<u>Kangaroo Creek Swamp – Newnes Plateau</u>

Corbett et al (2014) identified that groundwater levels at Kangaroo Creek Swamp appear to have been affected by the longwall mining of Angus Place LW940 and that measured groundwater levels have not returned to pre-mining levels. However, Kangaroo Creek Shrub Swamp is fed by a perennial spring. which is fed by the aquifer-aquitard systems within the Burralow Formation, was unaffected by mining and the creek remained permanently wet below the spring. This, together with the presence of healthy hanging swamps along the valley walls surrounding Kangaroo Creek Shrub Swamp, indicates that the water supply from the spring and valley wall seepage has not been interrupted by longwall mining and that groundwater inputs to the swamp hydrological system remain intact.

Flora monitoring at Kangaroo Creek Shrub Swamp indicated no trend of decreasing condition and that species abundance is not declining. Investigation of mining related impacts at Kangaroo Creek Swamp showed that high levels of differential subsidence movements were measured, including strains (up to 6 mm/m tensile and 26mm/m compressive) and tilts (up to 13mm/m), which were the result of controllable mine design factors. The mine design was subsequently modified through narrowing longwall void widths and increasing chain pillar widths in order to reduce subsidence and mitigate potential impacts to groundwater systems.

<u>Summary</u>

This literature review identifies impacts to upland swamps in areas where mining has been undertaken. However, a number of comprehensive, scientifically robust studies have identified that there is no direct causal link between subsidence associated with longwall mining and impacts to upland swamps. In all cases, other secondary factors, including fire and heavy rainfall, clearing and water discharge, have been implicated in identified impacts to upland swamps. In all the above examples, the consequences of subsidence, such as bedding plane separation or bedrock cracking, may temporarily result in a lowering of groundwater levels and increase the susceptibility of upland swamps to secondary environmental consequences.

For upland swamps on the Newnes Plateau, evidence suggests that these consequences are no greater than those experienced during periods of rainfall deficit, making differentiation between mining related impacts based on hydrology only and climatic variations difficult.

In summary, there is no example that establishes the catastrophic loss of an upland swamp as a result of subsidence.

Review of Swamp Hydrology and Swamp Flora Species

Review of aerial photography from 1949 to 2012 to define the extent of upland swamps over areas mined in the Southern Coalfield found a decline in the extent of upland swamps between 1984 and 2012, coincident with a dramatic collapse in rainfall across this period, but could not find any relationship between levels of subsidence and changes in the extent of upland swamps with patterns remaining random overall (Biosis 2015).

A detailed investigation of the geology and hydrogeology of Newnes Plateau swamps was conducted by McHugh (2013), which identified and detailed the stratigraphy of the Burralow Formation, with its multiple fine grained aquitard plies, which overlies the Banks Wall Sandstone. The aquitards were found to retard the vertical movement of groundwater into underlying strata. Instead, much of the groundwater present within the Burralow Formation is redirected laterally down-dip to discharge points in nearby valleys (valley wall seepage), which creates a permanent water source for the formation and maintenance of the Newnes Plateau Hanging Swamps (NPHS). In the case of Newnes Plateau Shrub Swamps (NPSS), precipitation is supplemented by moisture from groundwater sources to form several discharge horizons along the course of the host creek in which a shrub swamp is located. Valley wall seepage, together with direct in-gully input of groundwater via aquitards, permits continuity of hydration for the THPSS during periods of drought. The presence of the Burralow Formation is essential to the formation and persistence of both hanging and shrub swamps (McHugh, 2013). Corbett et al. (2014) found that baseline data from swamp piezometers indicates that swamp hydrology is variable along individual swamps on the Newnes plateau, and standing water levels are typically influenced by rainfall in the upper reaches and by groundwater in the lower reaches. The data from the swamp monitoring has shown that the hydrology of an individual swamp can be 'periodically waterlogged' or 'permanently waterlogged' or can vary along its length from 'periodically waterlogged' to 'permanently waterlogged', with transitional behaviour between. The natural complexity and variability of swamp hydrology means that the use of changes to standing water levels in swamps (as measured by swamp piezometers) as triggers for offsetting entire swamps is not valid.

Following the implementation of the University of Queensland Flora Monitoring (UQFM) at Springvale and Angus Place, baseline surveys have been conducted at a number of swamps on the Newnes Plateau. UQ (2015) reported that the results from this baseline survey demonstrated that there are measurable differences in vegetation cover and condition between transects in areas with high, stable water tables and those in drier locations. This result corresponds with the findings of previous work (Johns et al., 2015) that shows that the monitoring variables used by UQ (2015) do vary based on hydrology and should therefore be effective for detecting changes in upland swamp vegetation associated with changes in hydrology.

UQ (2015) recognised that the NPSS have distinct groundwater regimes that may be stable or fluctuating. The condition and composition of vegetation communities in NPSS varies as a result and this fundamental factor needs to be incorporated into an effective monitoring program (through identification and selection of wetland areas with periodically waterlogged hydrology to act as controls for monitoring wetland vegetation cover and condition in periodically waterlogged impact sites).

University of Queensland Flora Monitoring Methodology (UQFM).

Following extensive research on the Newnes Plateau over several years, the University of Queensland has developed a flora monitoring methodology with the power to detect change in swamp flora communities. The UQFM methodology is supported by several peer reviewed papers, published in scientific journals (cited in References below). The UQFM methodology has been implemented at several swamps on the Newnes Plateau (in parallel with current statutory monitoring requirements) in order to gather baseline datasets and to enable interpretation of results obtained.

The UQFM identifies five monitoring parameters are used in detecting impacts in Newnes Plateau Shrub Swamp communities. These parameters include:

1. Reduction in the number of native swamp species present.
2. Reduction in the condition of key species (qualitative scores 1-5).
3. Expansion of non-live ground cover (including bare ground and dead plant material).
4. Recruitment of non-swamp species (presently eucalypts).
5. Establishment of non-native weeds.

Based on the Monitoring Handbook Centennial Coal has developed an adaptive monitoring regime that includes a statistically valid sampling design, supported by clear monitoring objectives and trigger values that identify ecosystem trends where management intervention is required.

Although the UQFM methodology is not currently statutorily approved, consultation with OEH has been conducted and approval is being sought through Centennial Coal's Regional Biodiversity Strategy.

UQ (2015) is a report generated from the implementation UQFM methodology on the Newnes Plateau.

Partial Impacts to Swamp Flora Communities

One of the specific findings of UQ (2015) was that changes were detected at Kangaroo Creek Swamp which were consistent with drier conditions relative to control swamps. These changes included:

- Dieback of wetland understorey plant species dependent on high soil moisture (e.g. G. dicarpa)
- Significantly higher non-vegetated area extent (26% compared to 1-23% for control swamps)
- Significantly lower live green vegetation cover (41% compared to 38-77% for control swamps)
- Wetland vegetation in Kangaroo Creek Swamp was also in generally poorer condition (overall condition score of 3 out of 5).

It was noted in (UQ 2015), that:

- that all wetlands appeared drier when surveyed in October 2014 compared to previous visits (both control and impact sites); an observation supported by Bureau of Meteorology data showing below-average rainfall in the preceding year.
- Kangaroo Creek has the highest percentage cover of large trees (31.4%) of all wetlands surveyed during January 2015.

Based on one reference point (KC1 piezometer) was described as having a high, stable water table in the past, but the high percentage of large trees at Kangaroo Creek Swamp is indicative of a variable hydrological regime. The dry conditions (in excess of 300mm rainfall deficit (~30% of annual rainfall) in the previous 12 months) may also have caused the observed dieback to G. dicarpa, which also suffered localised dieback (to a lesser extent) in control swamps.

It is emphasised that the UQ (2015) surveys were conducted for the purpose of baseline data gathering and analysis, and that the survey results were intended to be used as a reference dataset, for comparing the extent of changes in shrub swamp vegetation cover, composition and condition over time between undermined and control swamps.

Partial Offsets for Partial Impacts to Swamps

The analysis in UQ (2015) raises the issues of transition of swamp flora communities evolving over time as a result of transition from permanently to periodically waterlogging, characterised initially by a change in condition of wetland vegetation (particularly amphibious species), and then changes in community composition from amphibious to terrestrial damp and/or dry habitat.

UQ (2015) identifies a specific relationship between hydrology (periodically vs permanently waterlogged locations) and species present (amphibious / terrestrial damp / dry habitat). This implies that within the NPSS classification there could be flora species composition change, which could be used to calculate partial offsets within a swamp where changes to hydrological regime were measured (from permanently waterlogged to periodically waterlogged), but the swamp community remained within the NPSS classification.

Specifically, changes in values of live green vegetation cover and non-vegetated area extent can both be indicative of drier conditions and/or vegetation dieback due to trampling or other disturbance. These values could be used as triggers for partial offsetting and to calculate the extent of partial offsetting.

Attachment 2 – Calculation of maximum predicted offset liability

7 July 2015

Andrew Rode
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AUSTRALIA SQUARE NSW 1215

Dear Andrew

Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species – Offset Modelling

Our Ref: Matter 20293

Biosis was engaged by the NSW Minerals Council to provide specialist input to the NSW Minerals Council on the proposed *Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species* (Swamp Offset Policy).

The Swamp Offset Policy states that "*offsets should be calculated using the Framework for Biodiversity Assessment (FBA) . . . assessed as a potential maximum (i.e. worst case scenario) . . . A 'maximum predicted offset liability' must be calculated . . . as the ecosystem credits equivalent to the predicted loss of the upland swamps vegetation types*". It has been assumed that the intent of this statement is to assume complete loss of the swamp.

To fully understand the implications of the Swamp Offset Policy, Biosis has undertaken some desktop modelling of potential outcomes arising from the use of the *Framework for Biodiversity Assessment* (OEH 2014) and associated calculator, and the assumption of complete loss.

The *Biodiversity Offsets Policy for Major Projects* (OEH 2014) does not provide guidance on subsidence impacts as they are "*not associated with . . . clearing of vegetation*". Given evidence for a very limited number of cases in which subsidence associated with longwall mining has resulted in the complete loss of upland swamp vegetation an alternative "worst case scenario" of transition from upland swamp vegetation to woodland was tested, along with transition of vegetation from wetter swamp types to drier swamp types. This alternate modelling was undertaken to provide an alternative assessment methodology for use with the calculator, one that represents worst case impacts to upland swamps observed to date.

Our methodology and the results of this assessment are presented below.

Methodology

This section outlines the data used for this modelling exercise. Data was modelled using the calculator associated with the FBA for the 'Development Site' and using the Biobanking calculator for the 'Biobank Site'. Unless stated otherwise, data was used for both the assessment of the 'Development Site' and the 'Biobank Site'.

Landscape value

Upland swamps used in this modelling occur within the Sydney Basin IBRA bioregion, and the Sydney Cataract - Hawkesbury/Nepean IBRA subregion.

Given the high degree of native vegetation cover where clearing has been limited to that required for fire trails, electricity easements, roads and mine infrastructure; native vegetation cover before and after development was assessed as being 91 to 95 per cent in the outer assessment circle and 96 to 100 per cent in the inner assessment circle.

Connectivity was deemed to be uninhibited with a linkage width of greater than 500 metres. Both overstorey and midstorey projective foliage cover (PFC) were assessed as being at benchmark condition. No impact to either linkage width or PFC will result from mining developments.

The upland swamps used in this modelling exercise are located within the Woronora Plateau Mitchell Landscape.

Vegetation zones and site attributes

Upland swamps in the Southern Coalfield align with two plant community types, consistent with the Coast Upland Swamp endangered ecological community (EEC):

- PCT978 – Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion
- PCT1078 – Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion

Two vegetation zones with an area of 1 hectare were modelled, corresponding to the two PCTs above. PCTs were assessed as being in moderate/good condition with a patch size of 1000 hectares given the extent of native vegetation on the Woronora plateau.

Data on upland swamp vegetation condition was collected at ten locations across eight upland swamps located across the Woronora plateau. Site value data was assessed using plot and transect surveys as per the methodology outlined in Section 5 of the NSW Biobanking Assessment Methodology (OEH 2014). Plot and transect surveys included:

- A 20 m x 50 m quadrat and 50 m transect for assessment of site attributes.
- A 20 m x 20 m quadrat, nested within the quadrat outlined above, for full floristic survey to determine native plant species richness.

Plot/transect survey data is provided in Appendix 1. Benchmark data, as well as field data, was used in the two scenarios modelling complete loss. Benchmark data, as well as field data, was also used to model the number of ecosystem credits generated at the Biobank site. For all other scenarios, real field data was used.

As mining developments will not result in the clearing of native vegetation and fauna habitat, it was assumed that only those threatened species reliant on surface water or groundwater systems would be impacted. Other species reliant on general vegetation were not assessed as being impacted and were excluded from the assessment. An assessment of geographic habitat features is provided in Appendix 2.

No list of EECs was able to be chosen when undertaking the modelling exercise. As EECs and critically endangered ecological communities (CEECs) are given a multiplier of 3 this was undertaken post-hoc.

Management scores

Management scores determine changes in site value score, and the offset required. To model credit requirements resulting from impacts to upland swamps from mining, three scenarios were modelled, as outlined in Table 1.

Table 1: Scenarios used to model changes in site value scores

Scenario	Inputs
Complete loss of upland swamp vegetation, as outlined in the Swamp Offset Policy	All site attribute scores following development were set to 0. This scenario was modelled using both benchmark data, as well as plot/transect data collected from a representative sample of upland swamps.
Transition from upland swamp vegetation to woodland/forest communities	Site attribute scores following development were determined by comparing benchmark scores for PCT1083 – Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion. Benchmark site attribute scores for this PCT were compared to benchmark scores for PCTs 978 and 1078. Changes in management scores are provided in Table 7 of Appendix 3.
Transition of vegetation from wetter swamp types to drier swamp types	Site attribute scores were modelled using a transition from wetter swamps types to drier swamps types. Changes in management scores are provided in Table 8 of Appendix 3.

To model ecosystem credits created at a Biobank site, default averted loss scores and increased management scores were used.

Results

Credits required and generated

This section outlines the results of the modelling undertaken, and provides a summary of the number of credits required under the scenarios outlined above (Table 2) and the number of credits generated at a Biobank site (Table 3).

Table 2: Ecosystem credit requirements for the scenarios outlined above

PC type code	Plant community type name	Complete loss using benchmark data	Complete loss using real field data	Transition to forest/woodland	Transition to drier swamps type
HN560	Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion	80	52	11	8
HN563	Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion	80	40	5	5

If complete loss of upland swamps vegetation is used to model 'worst case scenario' between 80 and 37 credits are generated per hectare. The number of credits reduces to between 9 and 3 credits per hectare if transition from upland swamp vegetation to forest/woodland communities is assumed. The number of credits generated drops to between 2 and 6 credits per hectare if transition from wetter to drier swamp vegetation is assumed.

Table 3: Ecosystem credits created at a Biobank site

PC type code	Plant community type name	Number of ecosystem credits generated using benchmark data	Number of ecosystem credits generated using real field data
HN560	Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion	5	6
HN563	Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion	5	6

The number of credits generated at a Biobank ranges from 5 to 6 credits per hectare. If vegetation within a Biobank site is at 'benchmark' condition any gains in site value are largely due to an averted loss score. For a site with vegetation outside benchmark condition some gain due to improvement in condition of vegetation occurs. However, this does not result in a significant increase in the number of credits generated per hectare.

Table 4: Offset ratios generated by the scenarios listed above

Scenario	Maximum offset ratio	Minimum offset ratio
Complete loss using benchmark data	16:1	13:1
Complete loss using real field data	10:1	7:1
Transition to forest/woodland	2:1	0.8:1

Scenario	Maximum offset ratio	Minimum offset ratio
Transition to drier swamps type	1:1	0.8:1

Ratios associated with an assumption of complete loss of upland swamp vegetation will result in some of the largest offset ratios yet seen for major projects in NSW. We believe that given the available data, a more reasonable 'worst case scenario' is the transition of upland swamp vegetation to forest/woodland vegetation. Given the number of upland swamps that have been mined beneath in the Western and Southern Coalfields, and the limited number of impacts observed to date, this still provides a conservative impact assessment.

Offset costs

A per unit credit cost is comprised of a Part A cost and a Part B cost. The Part A cost provides for the ongoing management of an offset. For upland swamps, which are in good condition, this is expected to be low. Part B costs are the costs that the landholder may seek to charge and may include things like:

- establishment costs (e.g. application fee)
- field assessment
- preparation of management plans
- land value
- opportunity cost
- return or risk margin.

Given the limited availability of upland swamp offsets, there is potential for landholders to charge a premium price for upland swamps credits, as has occurred for some highly restricted TECs. Review of recent credit transactions under the NSW Biobanking Scheme indicates that per unit credit costs are increasing, with some highly restricted Threatened Ecological Communities (TECs) reaching a per unit credit price of up to $31,465 per credit and other TECs reaching per unit credit prices of $7347 to $16,111.

Using these per unit cost estimates and the outcomes of the modelled scenarios in Table 2, the potential costs of offsets for upland swamps can be estimated. Assuming complete loss, benchmark condition and the highest per unit costs removal of mining beneath 1 hectare of upland swamps; the offset may cost $2,517,200, with costs ranging from $587,760 to $1,288,880 based on other estimates of per unit costs.

If the scenario of a transition to forest/woodland is used, the offset costs are likely to range from $346,115 per hectare at the highest end, to $117,221 and $36,735 per hectare at the moderate to low end.

Discussion

This paper assesses the potential outcome arising from the Swamp Offset Policy, based on a number of scenarios.

The assumption of complete loss of upland swamp vegetation will result in some of the highest per hectare credit requirements observed for major projects in NSW, with up to 80 credits required, and costs of $2,517,200 to $587,760 per hectare.

Modelling of a range of impacts, including transition from upland swamp vegetation to forest/woodland vegetation as well as from wetter to drier swamp types reduces these offset ratios to between 11 and 5 credits and costs of between $346,115 and $36,735 per hectare. These scenarios are based on the impacts resulting to upland swamps from subsidence associated with longwall mining that have been observed to date. The loss of upland swamp vegetation as a result of mining is a rare occurrence, with a very limited number of examples observed to date, particularly when the total number of upland swamps that have been mined beneath is considered.

This assessment provides a realistic assessment of the outcomes generated by the Swamp Offset Policy. We believe it also provides a method by which the current calculator associated with the *Framework for Biodiversity Assessment* (OEH 2014) can be used to model a realistic 'maximum predicted offset liability'. In our opinion, a more realistic 'worst case scenario' is transition of upland swamp vegetation to forest/woodland vegetation. This still provides a conservative impact assessment, with observed impacts likely to be less. The calculator can be used to model this transition, by comparing benchmark data for forest/woodland communities to site value data collected from upland swamps. This method can also be used to model 'partial impacts'; for example, changes from wetter to drier swamp vegetation communities

Please contact me if you have any enquiries.

Yours sincerely

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Appendix 1 – Biobanking plot/transect data

Table 5: Assessment of geographic habitat features within the study area

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Notes	Modelled site
ACUS-V1	40	0	0	52	36	88	0	0	0	4	PCT1078	Biobank
ACUS-V2	26	0	0	34	40	100	0	0	0	0	PCT1078	Biobank
CRUS3-V2	30	0	0	52	8	96	0	0	0	0	PCT1078	Development
BCUS4-V1	17	0	17	36	38	94	0	0	0	0	PCT1078	Development
CCUS1-V1	25	0	0	46	12	96	0	0	0	0	PCT978	Biobank
CRUS3-V3	46	0	4	46	32	92	0	0	0	5	PCT978	Biobank
BCUS11-V1	37	3	0	38	44	76	0	0	0	20	PCT978	Development
BCUS4-V3	26	6.5	56	26	36	64	0	0	0	2	PCT978	Development
CCUS3-V2	29	0	9	40	42	82	0	0	0	0	PCT978	Development
CCUS3-V3	45	1	10	28	48	79	0	0	0	62	PCT978	Development

Appendix 2 – Assessment of threatened species

Table 6: Assessment of ecosystem credit species and species credit species within the study area

Common name	Scientific name	Impact?
Ecosystem credit species		
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	No
Flame Robin	*Petroica phoenicea*	No
Gang-gang Cockatoo	*Callocephalon fimbriatum*	No
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	No
Greater Broad-nosed Bat	*Scoteanax rueppellii*	No
Little Eagle	*Hieraaetus morphnoides*	No
New Holland Mouse	*Pseudomys novaehollandiae*	No
Scarlet Robin	*Petroica boodang*	No
Spotted-tailed Quoll	*Dasyurus maculatus*	No
Turquoise Parrot	*Neophema pulchella*	No
Species credit species		
Broad-headed Snake	*Hoplocephalus bungaroides*	No
Eastern Ground Parrot	*Pezoporus wallicus* subsp. *wallicus*	Yes – 1 hectare of habitat
Eastern Pygmy Possum	*Cercartetus nanus*	Yes – 1 hectare of habitat
Giant Burrowing Frog	*Heleioporus australiacus*	Yes – 1 hectare of habitat
Green and Golden Bell Frog	*Litoria aurea*	No
Hibbertia puberula	*Hibbertia puberula*	Yes – 5 individuals per hectare
Large-eared Pied Bat	*Chalinolobus dwyeri*	No
Littlejohn's Tree Frog	*Litoria littlejohni*	Yes – 1 hectare of habitat
Prickly Bush-pea	*Pultenaea aristata*	Yes – 5 individuals per hectare
Red-crowned Toadlet	*Pseudophryne australis*	Yes – 1 hectare of habitat

Appendix 3 – Changes in management scores for modelled scenarios

Table 7: Changes in management scores following development for transition to woodland

Site attribute	Benchmark score	Assumed management scores for PCT 978 following development	Assumed management scores for PCT 1078 following development
Native plant species richness	39	3	3
Native over storey cover min	17	3	3
Native over storey cover max	27		
Native mid storey cover min	75	2	2
Native mid storey cover max	85		
Native ground cover grass min	1	1	2
Native ground cover grass max	10		
Native ground cover shrubs min	7.45	2	1
Native ground cover shrubs max	11.45		
Native ground cover other min	12.85	2	1
Native ground cover other max	16.85		
Number of trees with hollows	1	3	3
Total length of fallen logs	30	3	3

Table 8: Changes in management scores following development for transition from wetter to drier communities

Site attribute	Score before development for PCT978	Score before development for PCT1078	Assumed management scores following development
Native plant species richness	3	3	No change
Native over storey cover	1	0	Decrease by 1
Native mid storey cover	3	1	No change
Native ground cover grass	3	2	No change
Native ground cover shrubs	2	2	No change
Native ground cover other	1	0	Decrease by 1
Exotic plant cover	3	3	No change
Overstorey regeneration	0	0	No change
Number of trees with hollows	0	0	No change
Total length of fallen logs	0	0	No change