# 4 Discussion and Recommendations

This study has provided an in depth analysis into the presence of ASS over a large area of the Lower Hunter Estuary. The results show that ASS has a presence in the estuary, and in some cases this presence presents a high risk to the surrounding environment, particularly though acidification of ground and surface water. More often than not, the ASS risk can be managed and mitigated on a localised site basis. There are a number of management recommendations and future research opportunities discussed below for each of the five sites (summarised in table 20), as well as the wider Hunter and other coastal catchments.

## *4.1 Tomago Wetland*

Tomago Wetland is considered the second highest risk site (of the five sites assessed) for ASS production and discharge. Recommendations for mitigating the effects of ASS at Tomago include:

**Floodgate Management**

The results of this ASS study suggest acid is leaching from the soil into the main drains, particularly the Fullerton Cove Ring Drain, the North-South Drain and the Eastern Drain, resulting in drain water which is slightly acidic. Allowing estuarine water to flush Tomago's drains will neutralise acid leaching from the site, before it reaches the estuary. This could be achieved by opening the two sets of floodgates to allow the water level in the drains to rise and fall with the tide, and allow all but the highest tides and flood waters into the drains.

The Department of Environment and Climate Change, the managing agency for Tomago Wetland, has a plan in place for the management of the western floodgates to create conditions suitable for the re-establishment of saltmarsh habitat for roosting birds. DECC's project has fitted the western floodgates with Smart Gates on four of the five 1500mm pipes (as pictured in figure 26). Other ancillary works have been undertaken, such as clearing the drains of vegetation to aid water movement, the construction of a levee bank in the northern area of the wetland (to prevent salt water incursion into private land) and various pipe and flap adaptations to assist in water management.

It is recommended that the eastern floodgates undergo a similar assessment process, with the view of formulating a plan to manage the floodgates to flush the drains of the eastern part of the wetlands.

It should be noted that it is likely that Tomago's main drains intersect the acid sulfate soils layer. Should this level be exposed to air due to receding water levels (such as prevailing dry weather conditions or very low tides), the PASS layer could be further oxidised. Further information on the floodgate invert and drain depths is needed to confirm this risk and to suggest whether additional works are required, such as a water control structure to maintain water at a certain level within the drain at low tide.

**Caution When Conducting Drain Maintenance**

To date drain maintenance has involved clearing out reeds to improve the flow of water. Drain clearing should use a leaky bucket that allows water and sediment to remain within the drain. The main drains should not be further deepened, at risk of further penetrating the ASS layer. Any spoil incidentally removed from drains should be tested for ASS, and lime applied to neutralise acid as it oxidises.

Tomago has only one site (T1) ranked as a high ASS risk, due to the high levels of stored acidity and low subsoil pH. There is a difficulty in managing water at this site due to the distance from the floodgates, and also the close proximity to private property. The recommended management of the northern section of Tomago Wetland is that additional drainage channels should not be constructed, as this would cause a drop in the water table, oxidise more sulfides and cause an acidic plume to become mobile. As long as this site stays wet (when sampled much of the northern section of the Tomago Wetland was under ankle deep water), no additional acid should be produced in the subsoil.

**Water Quality Monitoring**

A change in water regime (from fresh to salt) will result in changes to vegetation, with die-off occurring in the freshwater species during initial tidal flushes. It is recommended that water quality be monitored throughout the initial stages of tidal inundation, particularly to record dissolved oxygen levels in the water, as an indicator of eutrophication.

**Assessment of Impacts of Fringing Development**

The risk of acid discharge resulting from the expansion of industrial areas on the wetland margins needs to be appropriately addressed. For example, the construction of any additional drains in this high ASS risk northern section of the wetland would need to be fully investigated. Furthermore, the potential increase in the volume of freshwater runoff from the wetland margins could potentially result in dilution of the acid buffering capacity of estuarine water in drain system.

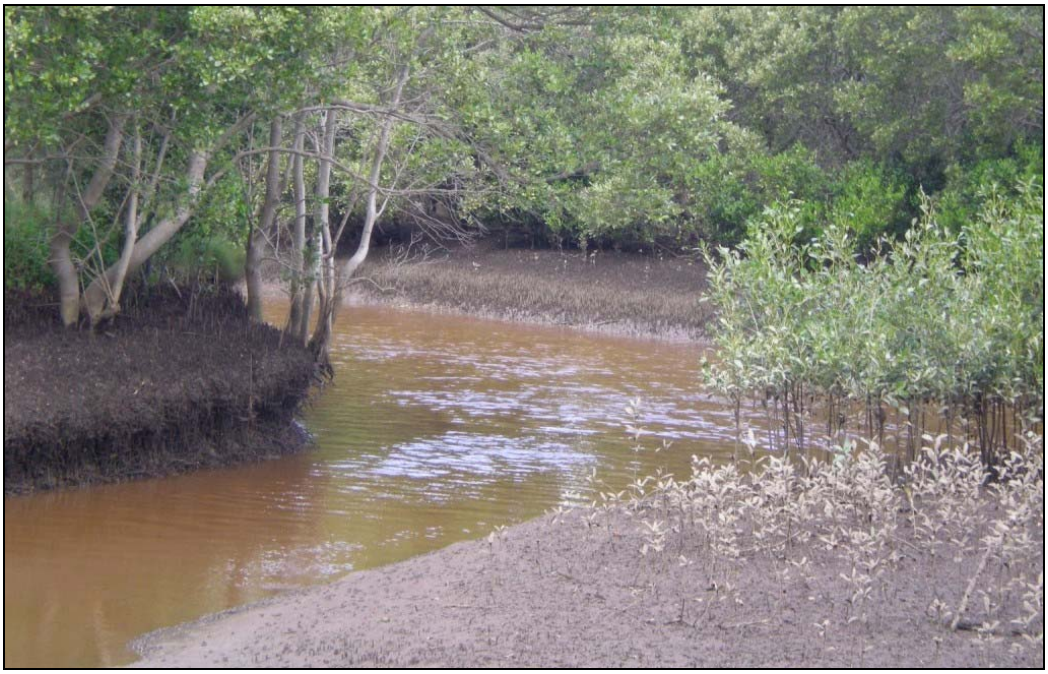


Figure 40: Floodgate management is recommended at Tomago Wetland to allow drains to be flushed by estuarine water

## 4.2 Fullerton Cove

The Fullerton Cove site is considered the highest priority (of the five sites assessed) for ASS management, due to the high level of stored acidity (TAA) in the subsoil profile, particularly adjacent to large drains (e.g. site F1). The study has shown that in some locations within the Fullerton Cove study site the ASS layer is within 0.3m of the soil surface. When the sulfidic layer is so close to the surface the key management principle is surface water management. Recommendations for mitigating the effects of ASS include:

**Floodgate Management**

At this site surface water is most actively managed for agricultural purposes. The system of floodgates, drains and levees can be used to benefit ASS management in this case. Acidic water leaving the disturbed landscape can be neutralised and diluted by tidal flushing. The landholders have expressed a willingness to actively manage the floodgates, opening them enough to allow tidal water to dilute and flush the drain. The recommendation for floodgate management should be associated with a series of bunds and retrofitting upstream side drains with flapped pipes to prevent tidal water from inundating nearby low lying farmland.

Due to agricultural use of the land east of the Fullerton Ring Drain, surface drainage is a priority for landholders. It is recommended that future drainage should utilise existing drains, and not construct new drains due to the shallow nature of the acidic soil. If it is absolutely necessary to construct a new drain it should be no deeper than 30cm, to prevent disturbance to the acid layer.

It is has been noted during this study that the 5m wide Ten Foot Drain intersects the acid soil layer. Should tidal flushing commence, there is a risk that the receding tide could draw the groundwater level near the drain down below the PASS layer, therefore exposing soils to oxygen. Spoil piles from recent drain cleaning, which removed sediment from the bottom of this drain, have shown shells exist at this depth. At this depth the soil may have a self-buffering capacity. Nevertheless, this drain should not be excavated any deeper.

The recommendation is that a Feasibility Study be undertaken to determine if this drain, and any other drain of depth, could be made wider and shallower to protect the subsoils from oxidation during the receding tide, whilst maintaining the drainage capacity of the system.

## 4.3 Kooragang

Kooragang Wetland (Ash Island Site) is considered a moderate risk of the production and export of ASS. There are a number of recommended management actions that could be used to mitigate ASS:

**Maintaining the Natural Water Regime**

All sites at Kooragang have been ranked as medium risk. This is due to the deeper nature of ASS at most sites, the natural water regime of the site and the absence of artificial drainage lines. The lack of artificial drains is an advantage in that most of the PASS layer has never, and is unlikely to be (under the current wetland management) oxidised.

Sites K4 and K5 in the central section of the Kooragang study site, are likely to be exporting small amounts of acid through groundwater, although due to the natural watering regime, this acid is being neutralised by the saline water before reaching the estuary.

In the higher elevated sections of the wetland, near sites K7 and K8, there is substantial stored acidity within 0.5m of the soil surface. Current management, including the absence of drains, maintains these sites at a lower risk. Therefore drains should not be constructed in the northern sites (i.e. around K7 and K8) to avoid the risk of mobilising significant amounts of acid.

Lower lying areas, particularly the permanent wetland sections of the site, provide little risk, given that they are permanently under water. Ponds, such as Swan Pond have a PASS layer at the soil surface, indicating sulfur in the brackish water has been reducing in the pond environment, producing sulfides. A risk would be created if these wetland areas were ever drained or allowed to dry out. Ensuring permanent inundation reduces the risk of this sulfide layer oxidising.

**Managing Surface Sulfide Accumulation in Recreated Saltmarsh Habitat**

The establishment of saltmarsh will create areas that are intermittently inundated. Intermittent inundation provides some risk of the creation of sulfides (through the reduction of sulfur in sea water) and oxidation of these sulfides when exposed to air as the tide recedes. This risk is considered low however, as on the next tide saline water should neutralise oxidising sulfides. A high frequency of inundation carries less risk of acid production than a low frequency which allows longer periods of drying.

**Treating Sulfidic Spoil**

Swales running across the Kooragang landscape act as natural drains, delivering tidal water to and from the site. These depressions are naturally becoming higher and drier as sediment collects in the low energy environment. To maintain this tidal inundation it may be necessary to remove barriers, such as pipe crossings, and dredge/ remove silt from the swale depressions (e.g. Dead Mangrove Creek). It is recommended that before these sediments are disturbed, they are tested for sulfides, as swales are a likely zone of sulfide accumulation. Treatment with lime to neutralise acid would be the recommended action if sulfidic sediments were dredged.

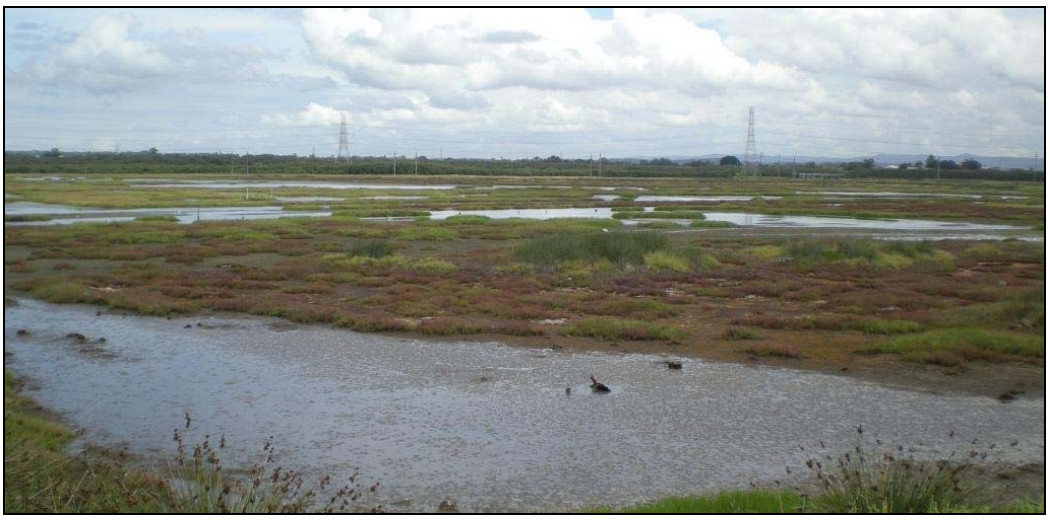


Figure 41: It is important to manage surface sulfide accumulation in recreated saltmarsh habitat at Kooragang Wetlands (photo: J Fredrickson)

## *4.4 Hexham Swamp*

During the ASS study at Hexham Swamp, there was limited access due to prevailing wet conditions, particularly the western and northern parts of the swamp. It is recommended further core samples be taken when drier conditions allow, to test soils in the western half of the swamp via Shortland residential area, and the northern parts of the swamp (Purgatory Creek catchment) via private land off Woodford Rd.

**Floodgate Management**

Analysis suggests moderate levels of acidity could leach from Hexham Swamp at times (e.g. from site H2). Allowing estuarine water to flush Ironbark Creek and Fishery Creek will neutralise acid leaching from the site, before it reaches the estuary. This could be achieved by opening the Ironbark Creek floodgates to allow the water level in the drains to rise and fall with the tide, and allow all but the highest tides and flood waters into the Creeks.

The Hunter Central Rivers Catchment Management Authority proposes to open these floodgates to restore tidal flushing, with the aim of restoring the natural wetland features of Hexham Swamp. The CMA has been facilitating an assessment of the impacts of staged opening of floodgates and has conducted works to mitigate the effects of saltwater intrusion on surrounding private property. Opening these floodgates is essential to mitigate the impacts of acid water discharge.

**Water Quality Monitoring**

A change in water regime (from fresh to salt) will result in changes to vegetation, with die-off occurring in the freshwater species during initial tidal flushes. It is recommended that water quality be monitored throughout the initial stages of tidal inundation, particularly to record dissolved oxygen levels in the water, as an indicator of eutrophication.

**Assessment of Impacts of Urban Development on Swamp Margins**

The risk of acid discharge resulting from the expansion of urban areas on the swamp margins needs to be appropriately addressed. For example, the potential for an increased volume of freshwater runoff from new subdivisions could potentially result in dilution of the acid buffering capacity of estuarine water in Ironbark Creek.

Figure 42: Birdlife in Hexham Swamp (photo: J Fredrickson)

## *4.5 Shortland Wetlands*

Much of the Shortland Wetlands is elevated above the estuary and therefore is not affected by ASS. Lower lying Ironbark Marsh, close to Ironbark Creek, is prone to ASS, with a high risk rating applied to site S2.

**Surface Water Management**

At present surface water runs though a series of wetland ponds and into Ironbark Creek, via pipes fitted with flap gates. Once Ironbark Creek floodgates are opened, these flaps will control estuarine water entering the lower wetlands.

In light of water quality problems in some of the wetland ponds, a recent report by BMT WBM (2008) recommends management options for improving water quality, based on a study of the wetland hydrology. Of the various management options presented in this report, there are two which may affect the ASS risk area:

- Strategy 2 (Re-establish Saltmarsh within Ironbark Marsh and Reed Marsh), and
- Strategy 5 (Lower Water Levels Throughout the Ponds).

At present site managers are considering the feasibility of implementing these options on the ground. Should these options be pursued, the following should be considered. If estuarine water is permitted to enter the lower wetlands (to re-establish saltmarsh as per Strategy 2) the site would be come intermittently drier. As the PASS layer is deep in the profile (approximately 1m below the surface) at site S2, it is unlikely that ground water levels would drop enough to significantly effect on acid production, i.e. oxidise the PASS layer.

Should a channel be cleared to enhance flow through the ponds (as per Strategy 5), additional ASS testing should take place to determine the depth of ASS in the works area. Any constructed channels should not be deeper than the sulfidic layer to avoid oxidation. Furthermore, it is possible that the soil surface at the bottom of the ponds is an area of sulfide accumulation and the risk of oxidation of sulfides should be considered before water levels are lowered.

**Recreating Saltmarsh Habitat**

The establishment of saltmarsh will create areas that are intermittently inundated. Intermittent inundation provides some risk of the creation of sulfides (through the reduction of sulfur in sea water) and oxidation of these sulfides when exposed to air as the tide recedes. This risk is considered low however, as on the next tide saline water should neutralise oxidising sulfides.

**Water Quality Monitoring**

A change in water regime (from fresh to salt) will result in changes to vegetation, with die-off occurring in the freshwater species during initial tidal flushes. It is recommended that water quality be monitored throughout the initial stages of tidal inundation, particularly to record dissolved oxygen levels in the water, as an indicator of eutrophication.

**Table 20: Summary of Recommendations**

| Recommendation | Floodgate manage-ment | Tidal inundation/ flushing | Additional earthworks to exclude saline water from pasture | Drain profiling | Drain alteration (shallowing and widening) | Water quality/flow observations | Maintain ground water height above PASS | Liming | Awareness of landholders and land managers | Site specific assessment before conducting earthworks |
|---|---|---|---|---|---|---|---|---|---|---|
| **Tomago** | | | | | | | | | | |
| Northern Tomago | Not Applicable | Not Applicable | Yes - have been constructed by DECC | No | No - additional drains should not be constructed | Yes | Yes | No | Yes – northern perimeter landholders | Yes |
| North – South drain | Yes | Yes | No | Yes | Yes - dependent on profiling | Yes | Yes - to prevent low tide receding below PASS layer | Yes – drain spoil potentially acidic | Yes – DECC | Yes |
| Eastern drain and Fullerton Ring Drain | Yes | Yes | Possible - on northern end of Ring Drain | Yes | Yes - dependent on profiling | Yes | Yes - to prevent low tide receding below PASS layer | Possible – if ASS is disturbed | Yes – DECC and private landholders | Yes |
| **Fullerton Cove** | | | | | | | | | | |
| 10 foot drain and Fullerton Ring Drain | Yes | Yes – ring drain and 10 foot drain | Yes – bunds along ring drain required | Yes | Yes – 10 foot drain | Yes | Yes | Yes – spoil pile from recent drain cleaning | Yes – private landholders along ring drain | Yes |
| **Kooragang** | | | | | | | | | | |
| City Farm and northern Kooragang | Not Applicable | Not Applicable | Not Applicable | Not Applicable | Important not to construct deep drains | Yes | Yes - Especially in Swan Pond where PASS is at surface | No | Yes – DECC and HCRCMA | Yes |
| Phoenix Flats and central Kooragang | Not Applicable | Yes – enhance natural regime | No | No | Possible – enhance flows in Dead Mangrove Creek | Yes | Yes | Possible – disturbed ASS in creek lines | Yes – DECC and HCRCMA | Yes |
| Swan Pond and southern Kooragang | Yes - Flow manipulation to enhance saltmarsh | Yes | No | No | No | Yes | Yes – PASS layer at soil surface in ponds | Possible if ASS is disturbed | Yes – DECC and HCRCMA | Yes |
| **Hexham** | | | | | | | | | | |
| Ironbark Creek and Fishery Creek | Yes | Yes | Yes - Have been constructed by CMA | Yes | Possible – at western end of Fishery Creek | Yes - especially during/after initial tidal inundation | Yes | No | Yes – DECC, CMA and private landholders | Yes |
| **Shortland** | | | | | | | | | | |
| Ironbark Marsh | Yes | Yes | Possibly | No | No | Yes - especially during/after initial tidal inundation | Yes | No | Yes – Hunter Wetlands Centre staff | Yes |

## *4.6 Future research*

**Other Wetlands in the Hunter Catchment**

Additional ASS Risk Investigations in other important tributary wetlands/ swamps in the Hunter Valley are required (see map, figure 43). Sites could include, but not be exclusive to:

1. Tilligerry Creek
2. Windeyer's Creek
3. Scotch Creek
4. Woodberry Swamp (Greenways Creek)
5. Tarro Swamp
6. Tenambit Wetland
7. McClements Swamp
8. Irrawang Spillway
9. Irrawang Swamp
10. Eskdale Swamp
11. Mosman Swamp
12. Woodville Swamps

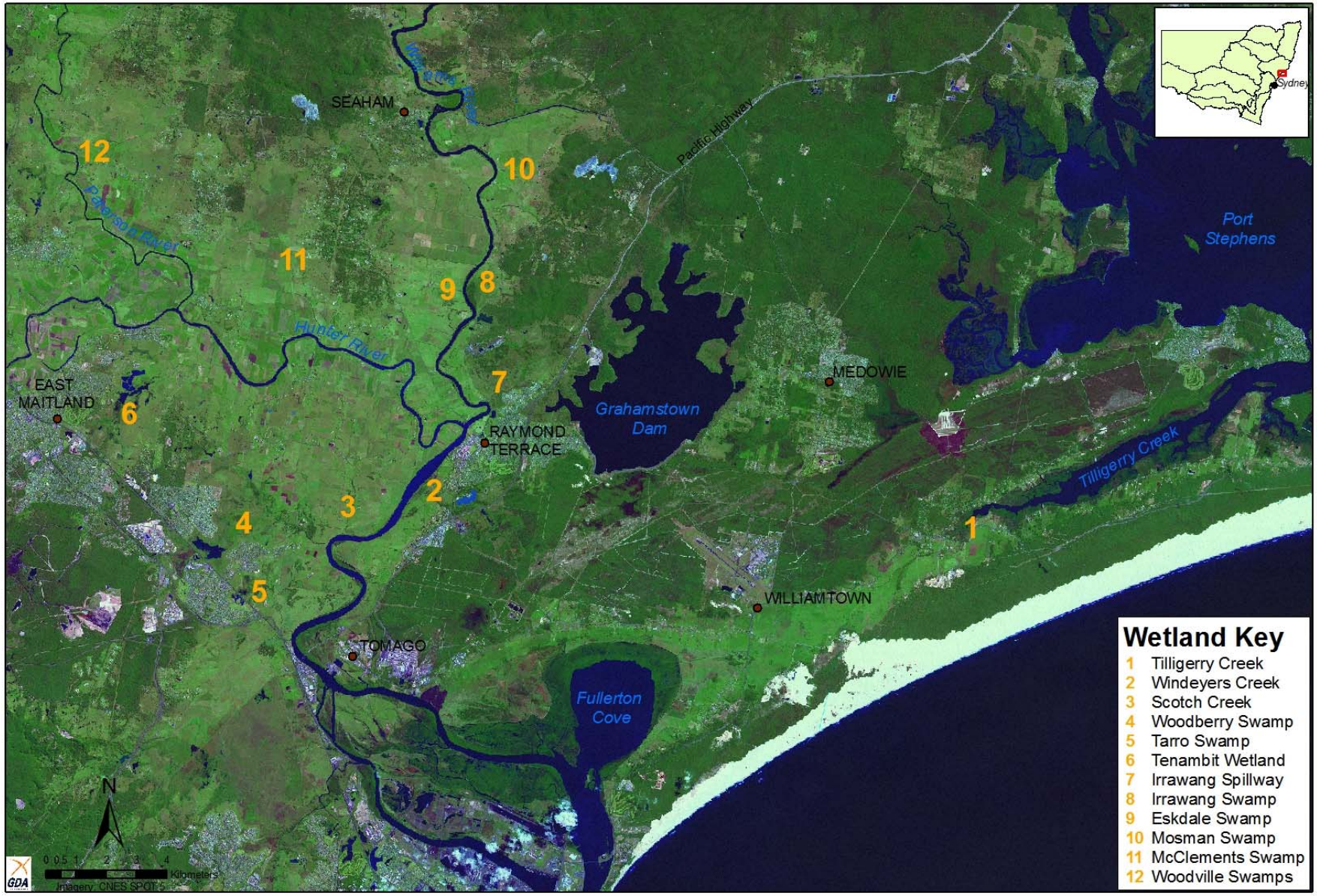
These sites have been identified by the revised ASS Risk Map as sites with potential risk. Floodgates at most of these wetlands have been identified by NSW DPIs Bringing Back the Fish project as priority sites for floodgate management to restore fish passage and a more natural tidal flushing regime. Further investigation is required into the impact of ASS on these wetlands areas to determine the impact opening floodgates may have on the wetland health. It is recommended that a process similar to this Lower Hunter ASS study be undertaken at each of the wetlands, involving collection and testing of soil core samples and assessment of hydraulic conductivity.

**Other Coastal Catchments**

As shown by figure 28 (page 27), there are numerous other coastal catchments with ASS, and varying areas subject to high risk. Investigation and management of ASS is more advanced in the northern catchments of NSW, and has typically been dealt with on a site or sub-catchment basis. There are no known ASS investigation reports compiling all available ASS information on a catchment-wide scale.

It is recommended that catchment-wide investigations reports be conducted for each of the coastal catchments (e.g. Karuah, Macleay Rivers), providing detailed site assessments and on ground works/ management recommendations for mitigating the effects of ASS.

**Figure 43: Wetlands Recommended for Future Acid Sulfate Soils Surveys**



### Monitoring the Effectiveness of Future On-Ground Works

On-ground works such as floodgate modification are becoming more common with the aim of recreating estuarine wetland conditions, improving fish passage opportunities and increasing habitat availability, and mitigating ASS. While there is limited localised monitoring studies and anecdotal evidence available, there is a lack of continuous detailed monitoring to determine whether there have been improvements to ASS, fish and general aquatic biodiversity following floodgate opening.

It is recommended that all future on ground works projects are associated with a scientifically rigorous Monitoring, Evaluation, Reporting and Improvement component. Furthermore research is required to determine the short-term and long-term effects of altering hydrological management options for 1) managing ASS, 2) conserving estuarine biodiversity and 3) conserving freshwater biodiversity in these wetlands.

### Develop Models for Bird Habitat (saltmarsh) Migration Patterns Under Predicted Sea Level Rise Using LiDAR

It is predicted that sea level rise is likely to increase in the region of 18 - 59 cm by 2100 (IPCC, 2007). This will see low lying areas, such as coastal wetlands, saltmarsh and mangroves becoming under increasing pressure. Using the LiDAR dataset acquired under the current project, it would be possible to model which areas would be affected by sea level rise and identify areas where coastal vegetation communities could migrate and establish.

Naturally, this would also affect the distribution of the faunal communities including birds dependent on those wetlands. A mapping product that showed areas which may prove suitable for preserving Ramsar Wetland values into the future would have some obvious merits.

### Mangrove Exclusion from Saltmarsh

One issue facing saltmarsh communities in the Hunter (and other regions) is the encroachment of mangroves. Mangroves generally occupy a lower micro-elevation than saltmarsh communities and a number of reasons have been speculated for the reason behind their movement onto saltmarshes. These include increases in rainfall, revegetation of areas previously cleared for agriculture, altered tidal regimes or estuary water levels, and increases in nutrient levels and sedimentation.

This encroachment is of particular concern for migratory bird values in the Hunter. Many important migratory species rely on saltmarshes to provide both a reliable food source and a safe roosting location. An attractive feature of large saltmarsh areas for these species is the lack of trees which could otherwise provide concealment for predators such as raptors and mammals. The presence of trees (including mangroves) is often enough to make migratory species reluctant to land there (Straw and Saintilan, 2006).

A number of options have been proposed and some limited trials undertaken to reduce mangrove encroachment. In Kooragang and the Stockton Sandspit, mangrove plucking has been employed to physically remove germinating seedlings. While successful over small areas and over a relatively short timeframe, this

technique faces challenges on different spatial and temporal scales (Straw and Saintilan, 2006).

While a number of alternative options for mangrove management exist, few have been trialled with any scientific rigor. Some options include:

- providing exclusion screens or floating booms at drain / saltmarsh interfaces, particularly during mangrove fruiting season;
- manipulation of the local hydrology to provide hyper-saline conditions that are more suited to saltmarsh growth then to that for mangroves;
- modifying land elevations to provide conditions suitable form saltmarsh recruitment.

It is recommended that these options be trialled at suitable sites available in the Hunter (especially for Tomago and Kooragang Wetlands).

**Future Communications of ASS Study Findings in the Lower Hunter**

The project communications achievements are presented in Appendix 9. In summary this project bought together a group of local experts and agency representatives to oversee and guide the project, achieved a series of Wet Pasture Management Workshops and communicated project outcomes through a number of publications (final report, ASSAY newsletter and other newsletters).

Promoting the project outcomes needs to be an ongoing process, requiring education of and consultation with a range of stakeholders, landholders, local authorities and the general public. Future communications objectives, in line with the Communications Strategy, could include additional wet pasture management workshops in the area, to demonstrate techniques for keeping formerly drained wetlands in a wetter condition, with benefits of improving pasture productivity, while also providing immense benefits for managing acid sulfate soils by retaining groundwater levels.

Results and Outcomes of this project will also be presenting at workshops and conferences relevant to coastal management.

## *4.7 Legislative considerations*

Works on waterways, flood prone land and in wetlands are subject to a variety of statutes, Environmental Planning Instruments and policies. Should future on ground works recommendations be pursued at any of the five sites identified in the Hunter Acid Sulfate Soils Investigations Project, this section should be used as a guide only (policy and legislation is often revised and amended, accuracy of this information cannot be assured). The provisions of current instruments and policies and their relevance to wetland rehabilitation works are outlined below:

**Legislation**

| Act | Responsibility | Notes |
|---|---|---|
| **Commonwealth** | | |
| Environment Protection & Biodiversity Conservation Act 1999 | Dept of Environment, Water, Heritage and the Arts (Comm) | Requires approval for activities that significantly affect matters of national environmental significance. These include Ramsar wetlands, threatened species and migratory species. |
| **State** | | |
| Coastal Protection Act 1979 and Coastal Protection Amendment Act 1988 | NSW Dept of Planning | An Act to constitute the Coastal Council of New South Wales and to specify its functions; to make provisions relating to the use and occupation of the coastal region; and to facilitate the carrying out of certain coastal protection works. The Amendment provides a new definition of the coastal zone defined by map references outlining the coastal zone, and extends three nautical miles out to sea. |
| Crown Lands Act 1989 | NSW Dept of Lands | Provides a regime for the ownership and management of Crown Land. |
| Environment Planning and Assessment Act 1979 | NSW Dept of Planning | The EP&A Act concerns all development activities that may have significant impact on the environment. NSW Department of Primary Industries and other state agencies (the Crown) are statutory authorities. Accordingly, Part 5A of the EP&A Act applies to development applications progressed by NSW DPI and other State Agencies (not including those covered by other planning instruments, e.g. SEPP14) that do not require a Part 4 approval from Local Council under a Local Environment Plan. |
| Fisheries Management Act 1994 | NSW Dept of Primary Industries<br><br>NSW Dept Environment and Climate Change | Establishes responsibility for management and protection of marine and estuarine fish resources and their habitats. Requires permits for fish habitat destruction. Provides for the protection of threatened species.<br>Provides for the management of Aquatic Reserves in NSW. There are not currently any Aquatic Reserves in the Lower Hunter Estuary. |
| Marine Parks Act 1997 | Marine Parks Authority | Provides for the gazettal and management of Marine Parks in NSW. There are currently no Marine Parks in the Lower Hunter Estuary. |

| Act | Responsibility | Notes |
|---|---|---|
| National Parks and Wildlife Act 1974 | NSW Dept of Environment and Climate Change | Relates to all areas reserved as national parks, historic sites, nature reserves, Aboriginal areas, state recreation areas and regional parks. There are numerous Parks and Reserves in the Lower Hunter Estuary area.<br>A licence is required to harm aboriginal artefacts and to take or kill any protected fauna and flora. |
| Native Vegetation Act 2003 | Catchment Management Authorities | Manages Native Vegetation preservation through Property Vegetation Plans. |
| Protection of the Environment Operations Act 1997 | NSW Department of Environment and Climate Change | DECC has powers to license activities that pollute water. There are heavy penalties for unlicensed pollution. |
| Threatened Species Conservation Act 1995 | NSW Dept of Environment and Climate Change, and NSW Dept of Primary Industries | Establishes a process for classifying and protecting endangered species and critical habitats. |
| Water Management Act 2000 | NSW Dept of Water and Energy and NSW Dept of Environment and Climate Change | Governs the issue of new water licences and the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced.<br>Part 2 deals with Hunter Valley Flood Mitigation Works. DWE oversees floodgate management.<br>Across the entire State, works within 40 metres of a river, lake or estuary require a controlled activity approval under this Act. |
| **Regional / Local Level** | | |
| Local Government Act 1993 | Local Government | Requires approval for building, waste management and sewerage and stormwater drainage. |

## Policies

| Policy | Responsibility | Notes |
|---|---|---|
| **Commonwealth** | | |
| Commonwealth Wetlands Policy 1997 | Dept of Environment, Water, Heritage and the Arts (Comm.) | National wetlands policy for managing wetlands on Commonwealth land, implementing commonwealth policy, working with states, territories and local governments, acting as a scientific basis for policy & management and international action. There is no Commonwealth land within the Lower Hunter Wetlands |
| **State** | | |
| The NSW Coastal Policy 1997 | Coastal Council of NSW | Ecologically sustainable development of the coast through water quality management, regulation, protection, restoration, SEPP14, conservation, reserve systems, ASS management, planning, cultural heritage protection, monitoring research & management. |
| The NSW Estuary Management Policy 1992 | NSW Dept of Environment and Climate Change | A component policy of the NSW State Rivers and Estuaries Policy 1993 for the protection and management of estuaries. |

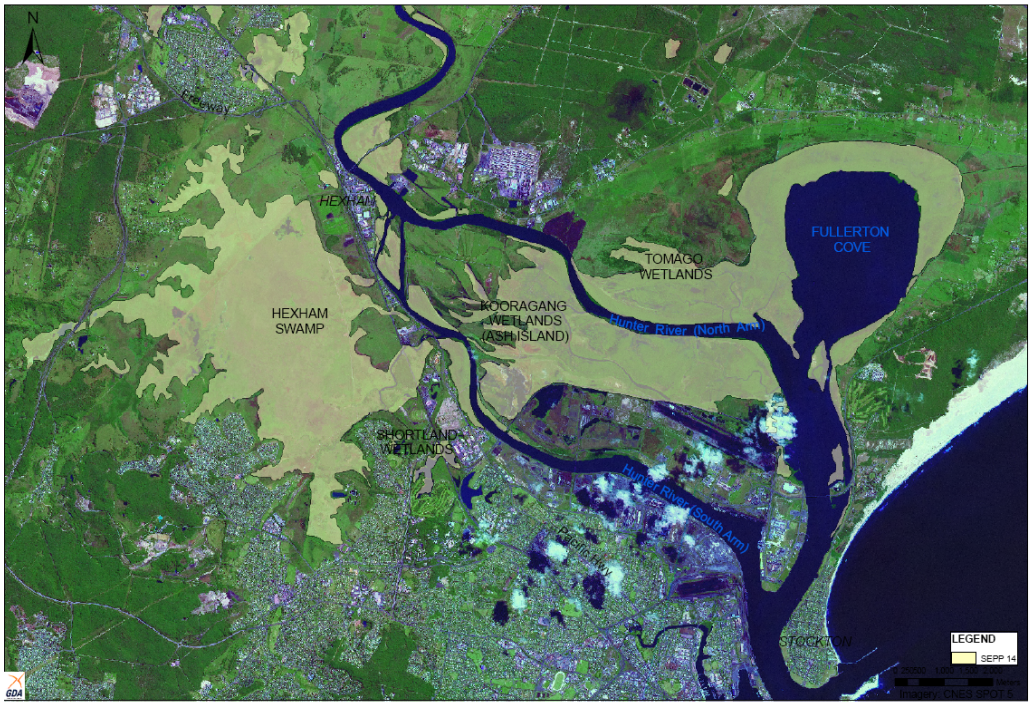
| | | |
|---|---|---|
| NSW Fisheries Policy and Guidelines - Aquatic Habitat Management and Fish Conservation 1999 | NSW Dept of Primary Industries | Provides background material and description of fish habitats and resources, relevant policies and legislation. Identifies activities that impact on aquatic habitats, compliance activities, guidelines for mitigating impacts, conservation activities and appropriate environmental assessment. |
| NSW Weirs Policy 1997 | NSW Dept of Water and Energy | Aimed at halting and where possible reducing and remediating the environmental impact of weirs. Eight management principles outline construction, removal, modification, regulation, maintenance, riparian protection, rehabilitation and respect for the impact of weirs. |
| NSW State Rivers and Estuaries Policy 1993 | NSW Dept of Water and Energy | Developed for the improved management of rivers and estuaries and their floodplains. The policy sets out six principles for sustainable management. |
| NSW Wetlands Management Policy 1996 | NSW State Wetland Advisory Committee | Sets out the objectives and nine management principles for the management of wetlands. |

### State Environmental Planning Policies

| SEPP | Responsibility | Notes |
|---|---|---|
| State Environmental Planning Policy No. 14 (SEPP14) - Coastal Wetlands | NSW Dept of Planning | Protects mapped wetlands in the coastal zone of NSW (outside the Sydney metropolitan region). Requires development consent (consent from Local Council and concurrence of Director of DECC) for the clearing, draining or filling of wetlands, or levee construction.<br>Relevant mapped areas include parts of Hexham Swamp, Shortland Wetlands and Kooragang Wetland. SEPP14 is not applicable within National Parks and Wildlife Act gazetted estate. |
| State Environmental Planning Policy No. 35 (SEPP35) – Maintenance Dredging of Tidal Waterways | NSW Dept of Planning | SEPP 35 provides for the carrying out of maintenance dredging without the need for development<br>consent, provided that:<br>- the extractive material consists of silt, sand, gravel, clay, turf, soil, rock, stone or similar substances, and<br>- the dredging consists of the winning or removal and the disposal of extractive material from the bed of a tidal waterway to enable the waterway:<br>(a) to continue to function as a tidal waterway, or<br>(b) to resume its function as a tidal waterway. |
| State Environmental Planning Policy No 71 – Coastal Protection (SEPP 71) | NSW Dept of Planning | SEPP 71 applies to land the whole or any part of which is within the coastal zone as defined in the policy. The Coastal Protection Act 1979 provides that the “coastal zone” includes the area of land shown on the maps outlining the coastal zone (see maps). In summary, the application of SEPP 71 is dependent on the location of any future proposed works. The entire Kooragang Wetland, Shortland Wetlands and Hexham Swamp areas are relevant to SEPP 71. Tomago Wetland and Fullerton Cove (private lands) are not. |

| | | |
|---|---|---|
| State Environmental Planning Policy (Infrastructure) 2007 | NSW Dept of Planning | The SEPP (Infrastructure) removes the need to obtain development consent from Local Councils for certain types of Critical Infrastructure on state land. However, assessment of the potential environmental impacts through completion of an SEE, REF, EIS and / or an SIS, may need to be conducted as necessary under Part 5 of the EP&A Act. Certain works still require consultation with Local Councils. |

**SEPP 14 Wetlands in the Lower Hunter**




## Regional Environmental Plans

| **REP** | | |
|---|---|---|
| Hunter Regional Environmental Plan 1989 | NSW Dept of Planning | Requires Council consent for clearing, draining, filling, construction of a levee or other development on any wetland specified by the REP (other than wetland under the control of DECC or DPI). None of the five wetlands covered by this study are specified by the REP. |

## Local Environmental Plans and Development Control Plans

At the local level, development is managed by the application of Local Environmental Plans and Development Control Plans. Relevant Plans are:

- Port Stephens Local Environmental Plan 2000
- Port Stephens Development Control Plan (DCP) 2007
- Newcastle Local Environmental Plan 2003
- Newcastle Development Control Plan 2005

Other local and regional policy documents include:

- Hunter Central Rivers Catchment Action Plan
- Hunter Estuary Management Study and Plan (draft)
- Tilligerry Creek Catchment Management Plan
- The Lower Hunter Regional Strategy.
- The Lower Hunter Regional Conservation Plan (draft)

**International Agreements that are Relevant to Wetlands in NSW**

| Agreement | Responsibility | Notes |
|---|---|---|
| Convention on Wetlands of International Importance - The Ramsar Convention | Dept of Environment, Water, Heritage and the Arts (Comm) and NSW Dept Environment and Climate Change at state level | The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an inter-governmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Lower Hunter Estuary wetlands is a Ramsar site. Ramsar wetlands are now protected under the Environment Protection & Biodiversity Conservation Act 1999. |
| China-Australia Migratory Birds Agreement (CAMBA) 1986 and Japan-Australia Migratory Birds Agreement (JAMBA) 1974 | Dept of Environment, Water, Heritage and the Arts (Comm) | Aims to ensure that the governments involved recognise the value of migratory birds by protecting those birds that migrate between Australia, Japan and China. |