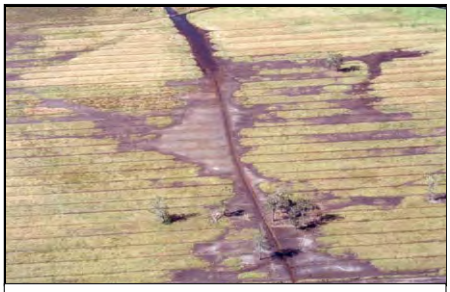
New South Wales Government

DEPARTMENT OF WATER AND ENERGY

WATER LICENSES AND ACID SULFATE SOILS

Note: This information is a summary only, and is intended as a simplified guide to assist in the assessment of water licences in areas identified on the acid sulfate soils risk maps (available from DWE) as having a probability of acid sulfate soil occurrence in near surface soils (to a depth of greater than 3m). It does not replace the Acid Sulfate Soil Manual 1998 (or subsequent editions), which should be used as the detailed reference for assessment, planning and management purposes.

Introduction



Scald in grazing paddock, Moto area.

In coastal acid sulfate soil areas associated with limited coastal aquifers, the management of acid sulfate soils and aquifers must be considered in the context of total catchment management.

Acid sulfate soils are those soils that contain iron sulfides. They are commonly formed in tidal conditions, and frequently occur in coastal floodplains within 1.0 m of sea level. They have often been covered with layers of floodplain alluvium and so may be buried well below ground surface. They have been found at depths greater than 10m below the surface, and (more rarely) at elevations of 15m above sea level. When iron sulfides are exposed to air, they react with oxygen to produce sulfuric acid.

Water licence applications for areas at risk of having acid sulfate soils require assessment of the likely impacts because:

- Extraction of water from the ground or from surface stores can lower water tables and expose potential acid sulfate soils to air, resulting in the production of sulfuric acid.
- Construction of dams and bores can disturb acid sulfate soils also resulting in sulfuric acid production (increasingly, such disturbance is managed by local government through implementation of Local Environmental Plans).
- Some of these areas have groundwater with high levels of acid which may contain metals such as aluminium, iron, and less commonly, other metals including arsenic, manganese, and cadmium. Such water can have environmental and health implications.

Acid sulfate soils can affect both soil and water as well plants and animals. Their impacts can be summarised as:

1. **Environmental**:
   - Sulfuric acid, in sufficient concentration, can be directly harmful to plants and animals. In addition it can dissolve clay minerals and release toxic concentrations of aluminium, iron and other metals into groundwater and estuarine systems leading to poor water quality and the death or disease of vegetation and aquatic animals. Groundwater, soils, and rivers can become contaminated.
   - Acid soils reduce the ability of plants to extract the minerals they need for healthy growth. Some weeds are tolerant of acid conditions.
   - De-watering of acid sulfate soils (which may be gel-like) can cause soil shrinkage and subsidence, leaving areas more prone to flooding and waterlogging, and sometimes damaging structures.

Aluminium acid plume from Ghinni Ghinni Creek

- Acid waters in rivers, creeks and wetlands are avoided by fish and other aquatic animals, reducing their habitat area.
- Chemical reactions in acid waters can lead to depletion of oxygen, resulting in waters lethal to animal life.
- Sometimes bare, scalded areas develop at the soil surface and persist for years, even decades. These bare scalds are prone to erosion.
- Soils irrigated with acid water can undergo soil structure degradation and can accumulate metals, causing problems for plants and animals.
- Water extraction can change groundwater flows and result in the lowering of groundwater levels elsewhere, especially lower in the catchment. If these areas have potential acid sulfate soils, their oxidation may occur as a result.
- Complex chemical and biological activity in acid sulfate soils can result in elevated levels of aluminium, iron, zinc, lead, manganese, cadmium, arsenic, and vernadium.

2. **Health** -

   Water supplies and creeks loaded with metals pose health risks for people and animals. High levels of aluminium, arsenic and other metals can cause serious side affects and illness in people and animals, including loss of productivity in farm animals. Acidic farm dams may be avoided by stock.

3. **Economic** -
   - Farm productivity can be affected by reduced plant growth, increased waterlogging or soil erosion in some areas, and reduced stock growth.
   - Creeks, wetlands and rivers can be affected by waters that are acid (low pH), contaminated with metals or have unsuitable levels of dissolved oxygen, hydrogen sulfide, or other compounds. These affect recreational and commercial fishing, and oyster production. In the worst cases serious fish kills can occur.
   - Acid water can corrode concrete and steel equipment and structures resulting in higher maintenance and more frequent replacement, for example of pumps, pipes, bridges, fences and culverts.

Soil subsidence and scalding from ASS

Activities that will impact groundwater in areas with acid sulfate soils

Extraction from

1) Groundwater excavations including farm dams that intersect the water table
2) Bores and spear points
3) Drains, including the removal of unwanted water from flood drains, after the removal of surface water (that is, discharge below mean ground level)

The following will <u>not be permitted</u> in areas mapped as having high or low probability for the occurrence of acid sulfate soils

Note 1: Acid sulfate soil risk maps are available from DLWC or the local Council
Note 2: Works and soil disturbance may require development approval from the local Council.

1. Extraction that results in a lowering of the water table at or near the extraction site, to a level equal to or lower than the level of actual acid sulfate soils in the aquifer, identified by laboratory tests (note that a buffer may be required to allow for evaporation and irregularities in the ASS layer)
2. Farm dams that contain acid water (pH below 4)
3. Extraction of water with a pH below 4.0
4. Extraction of water with a chloride to sulfate ratio of less than 2
5. Extraction of water with high levels of metals (eg iron or aluminium), based on laboratory tests.
6. Extraction that impacts on the sustainable recharge of the aquifer
7. Extraction that impacts on the sustainable management of the catchment

General principles to minimise acid sulfate soil impacts of water extraction

In areas where there are acid sulfate soils, the export of acid products and the risk of producing new acid from acid sulfate soils must be minimised. In general, the following management principles apply:

1. Groundwater should be of a quality that allows sustainable use at the receiving site. Most extraction sites with actual acid sulfate soils, or acid groundwater, will not receive a licence. If a licence is approved, conditions will be placed on the licence to ensure that impacts are minimised.
2. Should the proponent wish to pursue an application at extraction sites with acid water, a preliminary assessment or detailed studies will be required to define the water quality and soil parameters, and the potential impacts. For a licence to be issued, a management strategy will be required to ensure the impacts are kept to a minimum.
3. Groundwater levels will not be reduced below the level of acid sulfate soils. Where there is a risk of this occurring, a consultant (commissioned by the proponent) will identify a cease to pump level to a reference datum based on laboratory tests and elevation survey. A structural or design feature of the inlet (eg a set intake height) will generally be required to ensure compliance of the cease-to-pump level and this will be set as a condition of the licence.
4. In some circumstances it may be necessary to conduct additional aquifer and soil studies to establish maximum extraction rates.
5. Many floodgated flood discharge and stormwater drains also extract groundwater. In these circumstances, new drains may require a discharge control structure to ensure groundwater can not be lowered to the actual acid sulfate soil layer.
6. Extraction of water will not be licenced where the pH of the water falls below pH 4.0. Acid water may be neutralised prior to extraction.
7. Where animal and human health issues are relevant (eg stock and domestic use), water quality standards may need to include dissolved metals such as aluminium and iron.

Concrete corrosion

Further investigations that may be required to properly assess a groundwater extraction application in an acid sulfate soils area include:

A suitably qualified and experienced environmental consultant or equivalent is required to conduct the investigations. The report should clearly summarise the findings of the assessments and identify all potential risks related to the aquifer, acid sulfate soils and water quality, associated with the activity. The report should also assess potential impacts at the receiving site. If acid groundwater or acid sulfate soils (potential or actual) are identified, a management strategy will be required to ensure that impacts are minimised. The report should also consider the merits of alternative sites or actions that would reduce any identified risks.

A typical investigation and assessment of acid sulfate soils where an significant groundwater extraction is proposed may include the following:

1. Consultant's report to identify the occurrence and depth (preferably to AHD) of any actual and potential acid sulfate soils
2. Laboratory tests to confirm the occurrence of acid sulfate soils, and to determine the severity and depth of any acid sulfate soils
3. Field testing of the quality of water and groundwater, especially pH, and Electrical Conductivity (EC).
4. Laboratory testing of water to obtain chloride to sulfate ratio to indicate the presence of sulfates from sulfide oxidation
5. An assessment of the potential to expose potential acid sulfate soils to air as a result of groundwater drawdown. Depending on the specific situation, this may involve an assessment of the aquifer itself, as well as soil characteristics such as porosity and hydraulic conductivity. Note that extraction is likely to be greatest in the dry season, when the recharge potential of some aquifers is low. In some circumstances test pumping may be required.
6. Laboratory testing of water for dissolved iron and aluminium, and possibly other parameters, especially in circumstances where acid sulfate soil impacts on groundwater exist. This may also be relevant in relation to assessing long term impacts at the receiving site (eg soil degradation).
7. Other investigations as required. For example, with regard to dams and drains that intersect groundwater aquifers, elevation surveying may be required to establish the depth of any acid sulfate soils, and if required, establish a cease-to-pump level.

Iron rich drain water from ASS - Clarence estuary

The NSW Acid Sulfate Soils Manual 1998 (or subsequent editions) should be used to obtain details of sampling programs and water and soil assessments, and these should be carried out by a qualified Scientific Consultant in the fields of either: Environmental, Engineering, Soils or Groundwater.

Summary

Attached is a document detailing the minimum investigation requirements required for the specified Part 5 Groundwater License Application.

Irrigation Groundwater Licence Application Assessment Requirements for an Existing Excavation Located within Low Probability Acid Sulfate Soils

NAME: _____ DATE _____ DWE CONTACT: Chris Rumpf PH 66 416584
LOCATION:_____

INVESTIGATION	REQUIRED YES/ NO	COMMENTS
1. Identification of the occurrence and depth (to a reference datum) of any actual and potential acid sulfate soils (ASS)	YES	Field tests must be conducted by an environmental consultant or soil scientist according to procedures in the ASS Manual 1998.
2. Field testing of the quality of water and groundwater, especially pH, and electrical conductivity (EC).	YES	Must be conducted by an environmental consultant, through the water column for groundwater excavations, dams and drains.
3. Laboratory tests to confirm the occurrence of acid sulfate soils, and to determine the severity and depth of any acid sulfate soils	YES	Must be conducted by an environmental consultant or soil scientist. One borehole only is required, and samples taken at every soil layer or 500 mm to a depth of 4 m. The report must clearly identify the occurrence and depth of actual and potential acid sulfate soils, and the % inorganic sulfur.