

December 2008

Acid Sulfate Soils

Planning Guidelines





Cover Picture:

Acid sulfate soils scald in a dredge spoil pond at South Yunderup, Mandurah

Acid Sulfate Soils Planning Guidelines

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Introduction

Purpose of the guidelines

The *Acid Sulfate Soils Planning Guidelines* outline a range of matters that need to be addressed at various stages of the planning process to ensure that the subdivision and development of land containing acid sulfate soils is planned and managed to avoid potential adverse effects on the natural and built environment.

The guidelines have been prepared jointly by the Department of Environment and Conservation (DEC) and the Western Australian Planning Commission (WAPC), and replace the guidelines set out in *Planning Bulletin 64 Acid Sulfate Soils*.

When the guidelines should be used

On land depicted in either the DEC's geographic data atlas¹ or Landgate's shared land information platform WA atlas map viewer² or Landgate's interest enquiry service³ as being wholly or partially within an area of "high to moderate acid sulfate soils" (ie depicted in red) the guidelines should be used during the preparation and assessment of:

- regional planning strategies
- sub-regional planning strategies
- region planning schemes
- region planning scheme amendments
- local planning strategies
- local planning schemes
- local planning scheme amendments
- structure plans
- subdivision applications
- strata applications
- development applications.

1 DEC's geographic data atlas can be accessed at: <<http://www.dec.wa.gov.au/management-and-protection/acid-sulfate-soils/acid-sulfate-soils-in-western-australia.html>>.

2 Landgate's shared land information platform's WA atlas map viewer can be accessed at: <<https://www2.landgate.wa.gov.au/idelve/bmvf/app/waatlas/>>.

3 Landgate's interest enquiry service can be accessed through MyLandgate at: <<https://www.landgate.wa.gov.au/>>.

Underlying assumptions of the guidelines

The guidelines are based on the underlying assumption – supported by several years of practical experience with acid sulfate soils – *that acid sulfate soils are technically manageable in the majority of cases.*

The only exceptions to this would be in the case of marinas, boat harbours and canal estates. In these instances, acid sulfate soils may not be technically manageable because of the complex bio-geochemical and hydrodynamic processes that occur in the landscapes where these forms of development typically locate.

It should be recognised that the technical management of acid sulfate soils comes at an economic cost.

When assessing the overall feasibility of a particular proposal, project managers need to be aware that the cost of acid sulfate soils management may render a project economically unfeasible – particularly in those instances where ongoing management is required (eg maintenance dredging in canal estates).

Other sources of technical information about acid sulfate soils

The DEC has prepared the acid sulfate soils guideline series to assist agencies, developers and individuals to manage development in areas where acid sulfate soils may or will be impacted on.

The technical advice contained in the acid sulfate soils guideline series should be considered in addition to the material contained in these planning guidelines.

Copies of documents in the acid sulfate soils guideline series and further technical advice and information can be obtained from the DEC's website.

Additional information about acid sulfate soils

For more information about acid sulfate soils see appendix 3.

Guidelines

Objective of the guidelines

To ensure that the subdivision and development of land containing acid sulfate soils is planned and managed to avoid potential adverse effects on the natural and built environment.

General principles underpinning the guidelines

The following general principles underpin the guidelines, and seek to give effect to the objective.

Principle 1

Acid sulfate soils should be considered in all planning decisions to avoid potential adverse effects on the natural and built environment.

Principle 2

Disturbance of acid sulfate soils should be avoided wherever practicable.

Principle 3

Where the disturbance of acid sulfate soils is unavoidable, subdivision and development should be undertaken in a manner that:

- mitigates the potential adverse effects on the natural and built environment using the most appropriate mitigation strategies and management techniques; and
- achieves acceptable soil and water quality outcomes.

Principle 4

The rehabilitation of previously disturbed acid sulfate soils and existing acid drainage should be encouraged.

Guidance statements for: regional planning strategies; sub-regional planning strategies; region planning schemes; region planning scheme amendments; local planning strategies; local planning schemes; and local planning scheme amendments

These guidance statements seek to give effect to the general principles and the objective of the guidelines.

Guidance statement A1

Avoidance of disturbance where practicable

Where practicable strategies, schemes or amendments proposing any change of zoning that will lead to the introduction of, or an intensification of, development that is likely to result in significant amounts of excavation, drainage, or groundwater extraction⁴ on land depicted in either the DEC's geographic data atlas⁵ or Landgate's shared land information platform's WA atlas map viewer⁶ or Landgate's interest enquiry service⁷ as being wholly or partially within an area of "high to moderate acid sulfate soils" (ie depicted in red)⁸, should be avoided.

Guidance statement A2

Referral of marina, boat harbour and canal estate proposals to DEC

Strategies, schemes or amendments proposing any change of zoning **that will lead to the introduction of a marina, boat harbour or canal estate in any area** should be referred by the decision-maker to the DEC for advice prior to a decision being made.

Guidance statements for structure plans

The following guidance statements seek to give effect to the general principles and the objective of the guidelines.

Guidance statement B1

Acid sulfate soils investigation

Any structure plan involving land depicted in either the DEC's geographic data atlas⁵ or Landgate's shared land information platform's WA atlas map viewer⁶ or Landgate's interest enquiry service⁷ as being wholly or partially within an area of "high to moderate acid sulfate soils" (ie depicted in red)⁹ should address the issue of acid

4 This would include extractive industries, golf courses, marinas, canal estates, ornamental lakes, developments requiring deep sewerage or subsoil drainage systems, and developments with car parking and storage below ground level.

5 DEC's geographic data atlas can be accessed at: <<http://www.dec.wa.gov.au/management-and-protection/acid-sulfate-soils/acid-sulfate-soils-in-western-australia.html>>.

6 Landgate's shared land information platform's WA atlas map viewer can be accessed at: <<https://www2.landgate.wa.gov.au/idelve/bmvi/app/waatlas/>>.

7 Landgate's interest enquiry service can be accessed through MyLandgate at: <<https://www.landgate.wa.gov.au/>>.

8 Where more than one risk level exists at any one location within a site, the higher risk level is said to apply at that location.

9 Where more than one risk level exists at any one location within a site, the higher risk level is said to apply at that location.

sulfate soils¹⁰, and include an acid sulfate soils investigation that:

- Determines the likely presence and distribution of acid sulfate soils on the land, or alternatively, the absence of acid sulfate soils, based on at least step 1 of the DEC's *Identification and Investigation of Acid Sulfate Soils* guideline.
- Demonstrates the capacity of the land to sustain the pattern and distribution of proposed land uses having regard to:
 - 1 the likely extent and severity of acid sulfate soils;
 - 2 potential impacts on surface and groundwater quality and quantity;
 - 3 potential impacts on ecosystems and biodiversity;
 - 4 potential impacts on existing land uses in the vicinity;
 - 5 any likely engineering constraints and impacts on infrastructure; and
 - 6 cumulative impacts.

Guidance statement B2 Acid sulfate soils report

The results of the acid sulfate soils investigation should be documented in a separate acid sulfate soils report or, alternatively, in the written report required to accompany the structure plan¹¹.

Guidance statement B3 Avoidance of disturbance where practicable

Where practicable, the pattern and distribution of proposed land uses within the plan area should seek to avoid the introduction, or an intensification, of development that is likely to result in significant amounts of excavation, drainage, or groundwater extraction¹² on land where the presence of acid sulfate soils has been confirmed by an acid sulfate soils investigation.

Guidance statement B4 Referral of marina, boat harbour and canal estate proposals to DEC

Any structure plan **proposing the development of a marina, boat harbour or canal estate in any area** should be referred by the decision-maker to the DEC for advice prior to a decision being made.

¹⁰ Clause 6.2.6.1(b) of the Model Scheme Text provisions for structure plans states that a proposed structure plan is to contain, among other things, a site analysis map showing the characteristics of the site including:

- landform, topography and land capability;
- conservation and environmental values including bushland, wetlands, damp lands, streams and water courses, foreshore reserves and any environmental policy areas; and
- hydrogeological conditions, including approximate depth to water table.

Clause 6.2.6.1(f) of the provisions requires the preparation of a written report to explain the mapping, and to address the site analysis including reference to the matters listed in clause 6.2.6.1 (b).

Acid sulfate soils are a hydrogeological phenomenon and therefore fall within the scope of these provisions.

¹¹ For example, in the case of the Model Scheme Text provisions for structure plans, this would be the report referred to in clause 6.2.6.1(f).

¹² This would include extractive industries, golf courses, marinas, canal estates, agriculture uses requiring drainage systems, ornamental lakes, developments requiring deep sewerage systems, and developments with car parking and storage below ground level.

Guidance statements for: subdivision applications; strata applications; and development applications

These guidance statements seek to give effect to the general principles and the objective of the guidelines.

At this stage of the planning process, where land has been zoned and committed for urban development, it is often not possible to give effect to the ‘avoidance principle’ (ie principle 2).

Nevertheless, disturbance of acid sulfate soils should be avoided wherever practicable because management will *always* increase the cost of development.

For Applicants

Guidance statement C1

Acid sulfate soils investigation should ideally be undertaken at the application stage of the planning process

An acid sulfate soils investigation should be carried out if any dewatering or drainage works (either temporary or permanent), or the excavation of 100 cubic metres¹³ or more of soil is proposed:

- on land depicted in either the DEC’s geographic data atlas¹⁴ or Landgate’s shared land information platform’s WA atlas map viewer¹⁵ or Landgate’s interest enquiry service¹⁶ as being wholly or partially within an area of “high to moderate acid sulfate soils” (ie depicted in red)¹⁷; or
- on land where site characteristics or local knowledge lead the applicant to form the view that there is a high to moderate risk of disturbing acid sulfate soils at this location.

Guidance statement C2

Acid sulfate soils investigation should ideally be taken into account in the design of the proposal

The results of the acid sulfate soils investigation should be taken into account in the design of the proposal, and disturbance of acid sulfate soils should be avoided wherever practicable.

¹³ In lay person’s terms 100 cubic metres is about 10 standard-sized dump truck loads.

¹⁴ DEC’s geographic data atlas can be accessed at: <<http://www.dec.wa.gov.au/management-and-protection/acid-sulfate-soils/acid-sulfate-soils-in-western-australia.html>>.

¹⁵ Landgate’s shared land information platform’s WA atlas map viewer can be accessed at: <<https://www2.landgate.wa.gov.au/rdelve/bmvi/app/waatlas/>>.

¹⁶ Landgate’s interest enquiry service can be accessed through MyLandgate at: <<https://www.landgate.wa.gov.au/>>.

¹⁷ Where more than one risk level exists at any one location within a site, the higher risk level is said to apply at that location.

For Decision-Makers

Guidance statement C3

Referral of marina, boat harbour and canal estate proposals to DEC

Any application **that proposes or will facilitate the development of a marina, boat harbour or canal estate in any area** should be referred by the decision-maker to the DEC for advice prior to a decision being made.

Guidance statement C4

Approval conditions

Conditions drafted along the lines set out below should be imposed on any approval issued in response to an application involving land:

- depicted in either the DEC's geographic data atlas¹⁸ or Landgate's shared land information platform's WA atlas map viewer¹⁹ or Landgate's interest enquiry service²⁰ as being wholly or partially within an area of "high to moderate acid sulfate soils" (ie depicted in red)²¹; or
- where site characteristics or local knowledge lead the decision-maker to form the view that there is a high to moderate risk of disturbing acid sulfate soils at this location.

Subdivision and strata condition

An acid sulfate soils self-assessment form and, if required as a result of the self-assessment, an acid sulfate soils report and an acid sulfate soils management plan shall be submitted to and approved by the Department of Environment and Conservation before any site works are commenced. Where an acid sulfate soils management plan is required to be submitted, all site works shall be carried out in accordance with the approved management plan.

Development condition

An acid sulfate soils self-assessment form and, if required as a result of the self-assessment, an acid sulfate soils report and an acid sulfate soils management plan shall be submitted to and approved by the Department of Environment and Conservation before the development is commenced. Where an acid sulfate soils management plan is required to be submitted, all development shall be carried out in accordance with the approved management plan.

18 DEC's geographic data atlas can be accessed at: <<http://www.dec.wa.gov.au/management-and-protection/acid-sulfate-soils/acid-sulfate-soils-in-western-australia.html>>.

19 Landgate's shared land information platform's WA atlas map viewer can be accessed at: <<https://www2.landgate.wa.gov.au/idelve/bmvi/app/waatlas/>>.

20 Landgate's interest enquiry service can be accessed through MyLandgate at: <<https://www.landgate.wa.gov.au/>>.

21 Where more than one risk level exists at any one location within a site, the higher risk level is said to apply at that location.



appendices





Appendix 1

Acid Sulfate Soils Self-Assessment Form



Acid Sulfate Soils Self-Assessment Form



Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Applicant signature:

Date:

Submit form to the
Department of Environment and Conservation (DEC)
Locked Bag 104
Bentley DC WA 6983

If you have any questions relating to the Acid Sulfate Soils Self-Assessment Form, please contact the
Acid Sulfate Soils Section (DEC) on 1300 762 892 for assistance.

Version: 3.2 (November 2009)

Applicant

The applicant is the person with whom the WAPC will correspond and, if the application is approved, the person to whom the approval will be sent.

Full name

Applicant signature Date

Application property details

Step 1

Assess the possibility of acid sulfate soils disturbance

Question 1: Are any dewatering or drainage works (either temporary or permanent) proposed to be undertaken? yes no

Question 2: Is excavation of 100 cubic metres or more of soil proposed? yes no
(In lay person's terms 100 cubic metres is about 10 standard-sized dump truck loads.)

If no to both question 1 and question 2 then no further investigation is required at this stage. Please sign this form and submit it, together with a copy of the approved subdivision plan, to the Department of Environment and Conservation (DEC) with a request for clearance of the acid sulfate soils condition.

If yes to either question 1 or question 2 go on to step 2.

Step 2

Conduct an acid sulfate soils investigation in accordance with the DEC's Identification and Investigation of Acid Sulfate Soils guideline

Question 3: Did the acid sulfate soils investigation indicate that there are acid sulfate soils present? yes no

If no to question 3, then no further investigation is required at this stage. Please sign this form and submit it, together with the written results of the investigation (in the form of an acid sulfate soils report) and a copy of the approved subdivision plan, to the DEC with a request for clearance of the acid sulfate soils condition.

If yes to question 3, please sign this form and submit it, together with the written results of the investigation (in the form of an acid sulfate soils report), an acid sulfate soils management plan and a copy of the approved subdivision plan, to the DEC with a request for approval of the management plan.

Note: After completion of site works in accordance with the management plan you will be required to submit a closure report, prepared in accordance with the DEC's acid sulfate soils guideline series, to the DEC together with a request for clearance of the acid sulfate soils condition.

Tick box for attachments as appropriate:

Copy of approved subdivision plan.

Acid Sulfate Soils Report.

Acid Sulfate Soils Management Plan.

PTO for information on submissions
Version: 3.2 (November 2009)

1

Version: 3.2 (November 2009)

2

A copy of the form can be obtained by using the following link: <http://www.wapc.wa.gov.au/Applications/Subdivision+and+application/default.aspx> <<http://www.wapc.wa.gov.au/Applications/Subdivision+and+application/default.aspx>>



Appendix 2

Definition of terms used in the guidelines

Acid sulfate soils	Includes both actual acid sulfate soils and potential acid sulfate soils.
	Actual acid sulfate soils are soils or sediments that contain iron sulfides and/or other sulfidic minerals that have been oxidised, producing highly acidic soil horizons or layers. These materials are characterised by bright yellow or straw coloured mottles of the mineral jarosite and often contain dark reddish coloured streaks. Actual acid sulfate soils have a soil pH of 4 or less.
	Potential acid sulfate soils are soils or sediments which contain iron sulfides and/or other sulfidic minerals that have not been oxidised by exposure to air.
	The field pH of these soils in their undisturbed state is more than pH 4 and commonly neutral pH (approximately 7). These soils or sediments are invariably saturated with water in their natural state. The waterlogged layer may be peat, clay, loam, silt or sand and is often dark grey and soft but may also be dark brown, or medium to pale grey to white.
Acid sulfate soils management plan	Outlines the strategies to manage the potential impact of development works that are likely to disturb acid sulfate soils. The plan needs to specify all potential environmental impacts, performance criteria, and mitigation strategies together with relevant monitoring and reporting requirements, and where an undesirable impact or unforeseen level of impact occurs, the appropriate corrective action. Guidance on the format and content of acid sulfate soils management plans is contained in the DEC's acid sulfate soils guideline series which is available on the DEC website.
Acid sulfate soils report	A report that documents the results of an acid sulfate soils investigation.
Acid sulfate soils self-assessment form	The form set out in appendix 1 of these guidelines.

Acid sulfate soils investigation

An acid sulfate soils risk assessment process that is based on the procedures set out in the DEC's acid sulfate soils guideline series.

Boat harbour

An area of protected navigable waters where boats can shelter and where boat-to-shore (and vice versa) transfers of people or goods can be made and includes the associated land, breakwaters and dredged waterways.

Canal estate

A development or subdivision which adjoins or directly influences an existing or proposed artificial waterway. Any development where the titles to the subdivided lots extend into, abut or are proximate to a man-made waterway

Marina

A discrete set of facilities operating under one management body within a boat harbour which provides safe permanent moorings and other boat related services for a group of small craft. There may be more than one marina operating within a single boat harbour.

Appendix 3

Background on acid sulfate soils

About acid sulfate soils

Acid sulfate soils is the common name given to naturally occurring soil and sediment containing iron sulfides.

In Australia, the acid sulfate soils of most concern are those that formed in the Holocene geological period (the last 10,000 years) after the last major sea level rise. During the sea level rise new coastal landscapes were created as a result of rapid sedimentation, and acid sulfate soils were created when bacteria in these organically rich waterlogged sediments converted the sulfate from the seawater, and iron from the sediments, into iron sulfides.

These naturally occurring iron sulfides are generally found in a layer of waterlogged soil or sediment, and are benign in their natural state. When disturbed and exposed to air they oxidise and produce sulfuric acid, iron precipitates, and concentrations of dissolved heavy metals such as aluminium, iron and arsenic.

Location of acid sulfate soils

Acid sulfate soils occur throughout Australia, but have only recently come to prominence in land use planning as a result of the detrimental environmental consequences that can arise from disturbing them.

It is estimated that there are more than 90,000 square kilometres of naturally occurring acid sulfate soils in Australia. Approximately 30% (27,500 square kilometres) of Australia's acid sulfate soils are located in coastal Western Australia.

The areas in Western Australia currently considered to be most at risk of disturbance of acid sulfate soils are depicted in either the DEC's geographic data atlas²² or Landgate's shared land information platform's WA atlas map viewer²³ or Landgate's interest enquiry service²⁴.

In Western Australia, acid sulfate soils are likely to be found in, though not limited to, the following locations:

- the south–west of the State, between Perth and Busselton, in estuarine, floodplain and wetland areas;
- the north–west coastline including the Pilbara and Kimberley regions;
- the Scott River on the Scott Coastal Plain;
- Albany and Torbay on the south coast; and
- some parts of the Wheatbelt where land salinisation has occurred.

²² DEC's geographic data atlas can be accessed at: <<http://www.dec.wa.gov.au/management-and-protection/acid-sulfate-soils/acid-sulfate-soils-in-western-australia.html>>.

²³ Landgate's shared land information platform's WA atlas map viewer can be accessed at: <<https://www2.landgate.wa.gov.au/idelve/bmvi/app/waatlas/>>.

²⁴ Landgate's interest enquiry service can be accessed through MyLandgate at: <<https://www.landgate.wa.gov.au/>>.

At these locations, there could be a risk of disturbing acid sulfate soils in the following areas:

- areas identified as having a high to moderate risk of acid sulfate soil occurrence on government agency mapping, or on mapping from any other reputable source;
- areas depicted in the environmental geology maps published by the Department of Industry and Resources as Holocene swamp, tidal and estuarine deposits, or marshes and floodplains;
- areas depicted in the land system and soil-landscape system mapping by Department of Agriculture and Food or soil, geology or geomorphological mapping that indicate geologically recent shallow tidal, estuarine, marine, wetland, floodplain or waterlogged areas where deposition of fine sediments may have occurred or may be occurring;
- areas depicted in vegetation mapping as mangroves or wetland dependent vegetation such as reeds and paperbarks;
- areas identified in geological descriptions or in maps as bearing sulfide minerals or former marine or estuarine shales and sediments, or mineral sand deposits;
- coastal areas (including the Swan Coastal Plain) where the following pre-disposing factors exist:
 - areas known to contain peat or a build up of organic material;
 - areas near bores in which peat or other organic deposits have been recorded as part of the stratigraphy;
 - permanently inundated wetlands;
 - seasonally or occasionally saturated or inundated floodplains and sumplands;
 - shallow estuarine areas receiving alluvium and sulfidic black ooze;
 - mangrove areas;
 - tidal swamps, wetlands and shallow estuarine areas receiving alluvium and sulfidic black ooze;
 - artificial lakes excavated in peaty material;
 - sites known or believed to contain calcareous or pyritic material, such as:
 - sites containing untreated sulfide bearing fill
 - existing or former municipal waste disposal sites
 - industrial sites
 - food industry waste disposal areas
 - animal-based waste disposal areas;
 - areas where the highest known water table level is within three metres of the natural surface; and
 - areas where the pH of the soil or water is less than 4;

- any areas in Western Australia (including inland areas) where a combination of all the following pre-disposing factors exist:
 - organic matter
 - iron minerals
 - waterlogged conditions or a high water table
 - sulfate; and
- any areas where field tests, visual signs and other methodologies indicate that there is a likelihood of acid sulfate soils being present.

Why acid sulfate soils are a planning issue

Release of acid and heavy metals as a result of the disturbance of acid sulfate soils can cause significant harm to the environment and infrastructure.

The principal environmental, social and economic impacts of acid sulfate soils have been documented as follows:

- adverse changes to soils and water quality;
- deterioration of ecosystems and the ecosystem services associated with soils, groundwater, wetlands, watercourses and estuarine environments;
- local and regional loss of biodiversity in areas affected by acid sulfate soils leachate;
- loss of groundwater and surface water resources used for irrigation and other purposes;
- reduction in opportunities for agriculture and aquaculture;
- human health concerns particularly from arsenic contamination of groundwater in areas affected by acid sulfate soils;
- corrosion of engineering works and infrastructure such as bridges, culverts, floodgates, weirs, drainage pipes and sewerage lines;
- conflict between activities that depend on healthy surface and groundwater regimes (eg commercial fishing, recreation and tourism) and activities that may have resulted in disturbance to acid sulfate soils (eg agriculture and urban development);
- loss of visual amenity from plant deaths, weed growth and invasion by acid tolerant waterplants and algae; and
- costs to the community in terms of financial outlays and the community's and government's time and effort in minimising impacts and rehabilitating disturbed areas.

In Western Australia, the main impacts associated with acid sulfate soils to date have been:

- wetlands degradation;
- localised reduction in habitat and biodiversity;

- deterioration of surface and groundwater quality;
- loss of groundwater for irrigation;
- increased health risks associated with arsenic and heavy metals contamination in surface and groundwater, and acid dust;
- risk of long-term infrastructure damage through corrosion of sub-surface pipes and foundations by acid water; and
- invasion by acid tolerant waterplants and dominance of acid tolerant plankton species causing loss of biodiversity.

The Commonwealth Department of Environment and Heritage and the National Committee for Coastal Acid Sulfate Soils estimate that, without active management, up to \$10 billion worth of damage could be caused in coastal regions of Australia through damage to and loss of fisheries, agricultural productivity, wetland habitats, water resources, and through damage to urban structures caused by the corrosive effect of highly acidic soils and groundwater.

Therefore, the presence of acid sulfate soils is a planning issue that should be taken into account in planning decision-making.

The need to address acid sulfate soils early on in the planning process has become even more important with the introduction of the *Contaminated Sites Act 2003* which took effect on 1 December 2006. This is because land affected by the adverse impacts arising from the disturbance of acid sulfate soils may fall within the definition of “contaminated land” as defined in section 4 of the Act as follows:

contaminated in relation to land, water or a site means having a substance present in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value.

Types of development that may cause acid sulfate soil problems

The types of development that may disturb acid sulfate soils typically involve large-scale drainage and excavation works which expose these soils to air, and may include:

- coastal developments such as residential estates (including canal estates), marinas, tourist developments and golf courses;
- dewatering and drainage works associated with the development of residential estates;
- developments involving disturbance to wetlands, mangrove swamps, salt marshes, lakes and waterways;
- infrastructure projects such as bridges, port facilities, flood gates, dams, dredging, railways and roads;
- mining and quarrying operations;
- rural drainage, which lowers the water table; and
- flood mitigation works including construction of levees.

