

19 Geology, soils and site contamination

19.1 Introduction

This section describes the physical ground conditions of the study area and provides information on contaminated land, the potential for acid sulphate soils and the effects associated with local soils. Existing conditions were established through a combination of desktop analyses, preliminary assessments and limited sub-surface exploration. Further detailed investigations are planned as part of the planning and design process of the proposed Northern Expressway.

Some awareness exists in the community about contamination in relation to pesticides in agricultural areas and activities in the old munitions property. These are addressed in this section by mitigation and management measures during construction in particular.

19.2 Assessment methodology

The assessment of geology, soils and site contamination within the region has been based on the following:

- desktop review of existing information relating to regional geology, groundwater levels and soil types
- preliminary geotechnical investigations at bridge locations and adjacent to the Gawler River near Wingate Road
- review of the preliminary site contamination assessment of the wider study area undertaken by Parsons Brinckerhoff Australia in 2005.

19.3 Legislative requirements

19.3.1 State

Environment Protection Act 1993

The Environment Protection Act is the primary pollution control legislation in South Australia. The Act requires a 'duty of care' in relation to polluting activities. Breaches of the Act include:

- 'causing serious or material environmental harm or an environmental nuisance by polluting the environment'
- 'failing to inform the Environment Protection Authority (EPA) of an incident that has caused, or threatens to cause, serious or material environmental harm as soon as reasonably practicable'.

National Environment Protection (Assessment of Site Contamination) Measure

The National Environment Protection (Assessment of Site Contamination) Measure (NEPM), which provides a nationally consistent approach to site contamination assessment, forms an Environment Protection Policy under the Environment Protection Act.

The *Environment Protection (Site Contamination) Amendment Bill 2005* has been proposed as an amendment to the Environment Protection Act, to provide a statutory framework for the effective assessment and management of contaminated sites in South Australia.

Stormwater Pollution Prevention Code of Practice for Local, State and Federal Government

The *Stormwater Pollution Prevention Code of Practice for Local, State and Federal Government* (EPA 1998) is intended to inform government agencies and their contractors of their 'general environmental duty' with respect to stormwater under the *Environment Protection Act 1993*. The code provides for the preparation of a Soil Erosion and Drainage Management Plan (SEDMP) where there is a risk of significant sediment pollution to adjoining lands or receiving waters.

19.4 Existing conditions

19.4.1 Physical environment

The proposed Northern Expressway is located on the Northern Adelaide Plains between Gulf St Vincent and the Mount Lofty Ranges. The land rises gently from the gulf with slopes from less than 0.2% near the coast, to about 2% below the footslopes of the ranges.

The land surface where the Expressway will be constructed slopes gradually from about 40 m Australian Height Datum (AHD) at the Gawler Interchange to 10 m AHD where it will connect with Port Wakefield Road.

19.4.2 Regional soils and geology

The soils along the route vary only slightly with well-drained, high strength, reddish brown clays for most of the length. Adjacent to the coastline and at the lowest elevation, the soils are of marine/estuarine origin. They are poorly drained, often saturated and of lower strength, and may contain potential acid sulphate soils.

19.4.3 Erosion potential

Most local soils are prone to erosion by running water, although existing channels and drains show that erosion processes are slow. Generally, the more vertical the face in any cutting, the more susceptible it will be to erosion due to the shrinkage, cracking and slaking processes in the clay horizons below the topsoil. Embankment faces with low slopes are less likely to erode but will still result in a gradual accumulation of clays and silts in the bottom of drainage features.

The proposed Northern Expressway crosses drainage channels and rivers that flow from the ranges to the coast. Flows along these are intermittent, and erosion and sedimentation are an ongoing dynamic process. The land is almost flat between the drainage lines which means that surface run-off will drain slowly and may have implications on soil behaviour.

Surface sands, which are remnants of old sand dunes, are loose and prone to wind erosion when bare. Such soils occur mainly north of Womma Road to the Gawler River. Minor erosion and drifts were noted in road cuttings and in agricultural areas north of Gawler where some ploughing had left bare, disturbed soil.

19.4.4 Site contamination

A preliminary assessment of the study area was undertaken to identify significant contamination issues that might present a risk to the project or pose a liability to DTEI (PB 2005).

The investigation comprised:

- a review of zoning and permitted land uses (local development plans)
- a review of historical aerial photographs
- limited drive-by inspections of the area
- a review of the regional geology and hydrogeology
- a review of in-house archives to identify known or suspected sources of contamination
- identification of historical or current potentially contaminating land uses in the area.

The study identified sites of potential contamination based upon current and past land uses. Those identified as applying to most of the study area included:

- storage and use of agricultural chemicals associated with horticultural activities
- unknown status of fill material imported into the study area
- use of pesticides beneath former and existing structures
- fuel storage on agricultural properties
- stockpiling of wastes on properties throughout the area.

Localised activities that may have caused contamination issues were also identified in the preliminary investigation. The categories include potential fuel leakage at sites with fuel storage, biological issues associated with several cemeteries, use of weedicide along rail lines, landfill operations, the operation of the Smithfield Magazine Area, the operation of a firing range, and the operation of wrecking yards and other light industrial premises.

19.4.5 Acid sulphate soils

Acid sulphate soils are naturally occurring sediments that comprise iron sulphides which are a product of natural reactions between iron-rich sediments, organic matter and sulphate-rich sea water present in low energy estuarine environments. Acid sulphate soils are widespread in low-lying areas of coastal Australia particularly where landform elevations are less than 5 m AHD (e.g. mangroves).

Undisturbed acid sulphate soils within the subsurface profile are generally in an anaerobic state with a pH of neutral to slightly alkaline. These soils are called potential acid sulphate soils. Actual acid sulphate soils are the oxidised form that results from disturbance including changes in groundwater levels and/or when potential acid sulphate soils are exposed to air. When these sulphides are disturbed and exposed to air, oxidation occurs and sulphuric acid is produced.

Acid sulphate soils have been identified in the Port Adelaide/Gillman region of South Australia. The coastal areas at risk of acid sulphate soils have been mapped (*Atlas of South Australia*). Acid sulphate soils are also known to occur at higher elevations; however, within South Australia their extent is

unknown. The soils within the study corridor are inland and therefore have yet to be classified in relation to risk or potential risk of acid sulphate soils.

19.5 Effects of the project

19.5.1 Soils

In general, the potential effects of the proposed Northern Expressway construction on soils include:

- topsoil loss after disturbance and erosion by wind/water, leading to dust nuisance and siltation of drainage lines
- erosion of cut faces and embankment batters. Soil particles from cut faces may accumulate in drainage features, possibly retarding flows in the long term
- saturation of areas where water ponds in drains or basins for long periods
- settlement of buildings on low density soils due to construction work involving heavy equipment and pile driving, or traffic vibrations
- heave and settlement of footings on reactive clays due to drainage alterations.

The characteristics that determine how the landscape will react are closely linked to soil profile characteristics, surface cover, and internal and external drainage. Materials covering or forming the upper layer of the land are of importance when considering the consequences of construction and long-term stability of the area. Along the route, these materials are all fine grained, consisting of sands, silts and clays.

19.5.2 Site contamination

While there is potential for contaminated soil to be encountered on the land excavated during construction, the extent of existing contamination is currently unknown. Contaminated soil may be related to human activities, or naturally occurring such as actual or potential acid sulphate soils. Acid sulphate soils are discussed separately throughout this section.

Key areas of risk with respect to site contamination include:

- exposure of construction workers to pre-existing contaminants directly
- exposure of other (e.g. off-site) human or environmental receptors to pre-existing contaminants as a result of construction activities (e.g. from mobilisation or disposal practices)
- introduction of new contaminants during construction (e.g. construction-related chemical spills).

If site contamination is not managed, soil contaminants may be released to the environment through contact with stormwater or creation of dust, either in situ or at the disposal location.

Mitigation methods will be implemented to avoid any further site contamination from construction activities.

19.5.3 Acid sulphate soils (naturally occurring)

Various construction activities have the potential to disturb and activate acid sulphate soils, including the construction of embankments, water treatment structures, piers, footings and noise barriers, or the stockpiling, removal and replacement of soil material at the worksite and at disposal points.

The severity of acid sulphate soils impacts are dependent upon soil characteristics, the depth of occurrence, and period and frequency of acid sulphate soils exposure. Although not yet formally classified, the risk of acid sulphate soils being present along the proposed Northern Expressway is considered very low due to the natural surface elevations being above 5 m AHD, and the lack of excavation activities requiring a significant depth.

19.6 Environmental management

Mitigation measures for the project will implement management and monitoring practices (from the planning and design phase and throughout the construction phase) that align with accepted industry practice. Appropriate management of site contamination and acid sulphate soils issues will rely on early identification during the planning and design process.

19.6.1 Specific actions to minimise effects during planning and design

A Construction Environmental Management Plan (CEMP) will document environmental controls and measures to be implemented during the construction phase of the project. This document will be developed to mitigate risks associated with:

- moisture changes in the sub-grade and reactive clays
- soil erosion and topsoil management
- low density soils
- accidental spills and leaks and spill response
- excavation of potentially contaminated land
- disturbance of acid sulphate soils.

A more extensive geotechnical testing program will be carried out to assist with the management of local soils and geotechnical issues. Testing will confirm the design requirements for stable embankments, footings and road pavements. Road drainage will be designed to keep sub-grade moisture conditions stable, particularly where reactive clays are present.

A preliminary site contamination investigation will be undertaken during the design phase of the project. This investigation will involve an assessment of the potential for each property to be significantly impacted upon by historically contaminated activities. From this investigation, sites will be subjected to a qualitative risk assessment and assigned as low, medium or high risk. Medium and high risk sites will be subject to a site history assessment which will involve a detailed assessment of historical land uses at the site through information such as historical aerial photography, anecdotal information, council and other public records, and a site inspection. Where it is considered possible that the site has been impacted upon by contaminating activities, an appropriate soil testing program will be undertaken to delineate these potential risks.

The risk of encountering actual or potential acid sulphate soils on the new Expressway route is considered low. If encountered, the mitigation and management measures for controlling impacts will be developed in accordance with the *Acid Sulphate Soil Manual* (Stone, Ahern and Blunden 1998), and will include best practice in management and monitoring (design, pre-construction and construction phases) to ensure potential environmental impacts are minimised and controlled.

19.6.2 Specific actions to minimise effects during construction

Topsoil management and erosion control

The suitability of erosion and sediment controls depends on the soil, landform and hydrological characteristics of the site. As these characteristics vary across the extent of the proposed alignment, a range of control measures will be implemented during construction.

Topsoils along the proposed route are generally weakly bonded when dry and easily disturbed by construction traffic. Periodic wetting of areas will assist in reducing dust, but care is required to ensure that excessive amounts of water are not applied therein creating additional problems.

Sheeting of access roads and staging areas will help control dust and erosion. Removal of the upper 150 to 200 mm of the topsoil may also assist as it will expose the stronger clayey soils below, but the clays may also be problematic during wet periods.

Dust creation by construction vehicles will be less problematic in sandy topsoils, which are instead prone to rutting and wind erosion. In this case, construction traffic should be restricted wherever possible to prepared access tracks and staging areas which have been paved.

Topsoil removed will be stockpiled at temporary locations along the alignment. All stockpiles would be protected by temporary seeding if necessary, together with other erosion and sediment control measures as required. The location of stockpiles and procedures required for management will be included as a component of the CEMP.

Erosion and sediment control measures may include:

- ponding basins and silt traps in new drainage lines and to capture construction site run-off
- revegetation of embankments and mounds
- protection of batter slopes in drainage lines with geotextiles or topsoil placed over clay lining of low permeability.

Effects on existing structures

The location of all buildings close to the Expressway will be noted and foundation conditions assessed. If it is considered that there is the potential for building movement due to alterations to the existing drainage system or the effects of construction traffic, appropriate measures will be taken to minimise damage. Dilapidation surveys will be carried out on these buildings to establish their condition before the commencement of construction.

Site contamination

Where contamination is identified at a site from investigations during the design phase, and where there is a potential risk to human or environmental receptors, a Contamination Management Plan will be implemented to manage these risks. The Contamination Management Plan will be based on the DTEI specification for managing environmental issues during construction activities, which is in turn based upon

the Environment Protection Authority Guidelines for Environmental Management of On-Site Remediation. Where significant site contamination is identified, it is intended to develop the Contamination Management Plan with the Environment Protection Authority to ensure the management strategy adopted is consistent with environmental protection standards.

As a minimum, the Contamination Management Plan will be required to address and cover the following environmental requirements:

- earthworks involving excavation of potentially contaminated soils
- management of dust resulting from excavation, dumping and placement of excavated soils
- management of potentially odorous emissions from wastes or contaminated soil
- Occupational Health and Safety requirements for workers directly involved in excavation of contaminated soils
- erosion control including provision of adequate bunding
- management of any stockpiled soils and contaminated materials, taking care not to cross-contaminate nearby clean soils, and locating stockpiles in areas of least disturbance to flora
- provisions to ensure that contaminated soil is not transported offsite through adherence to construction plant
- surface water drainage controls to ensure that contaminants are not mobilised off site and surface water resources are protected
- consideration of potential adverse impacts to groundwater quality
- handling and possible disposal of potentially hazardous waste materials
- off-site disposal of contaminated soil to licensed waste repositories
- access to the site during excavation activities that may expose people to contaminated soils.

All potentially contaminating materials used on site will be listed in a Hazardous Materials Register, including storage location details and requirements, proper usage, safe handling procedures and appropriate disposal procedures. All chemical and fuel storage areas and bund facilities will be designed to comply with relevant Australian Standards. Fuels or other chemicals used during construction will be handled in accordance with these standards and accepted industry practice so as to minimise the risk of spills.

Appropriate spill response and containment equipment will be kept at the site in close proximity to storage and handling areas. Spills and leaks will be cleaned up and remediated promptly.

Acid sulphate soils

If acid sulphate soils or potential acid sulphate soils are identified during the next stages of the investigations, appropriate steps will be taken at the design stage to ensure they do not have a long-term detrimental effect on the environment.

19.6.3 Specific actions to minimise effects post-construction

If any site contamination or area of acid sulphate soils on the corridor requires ongoing management beyond the construction period, this will be included in the operational specification for the Expressway.

19.7 Conclusion

Soil and geological conditions along the proposed Northern Expressway corridor vary, but generally consist of fine-grained materials prone to a number of issues including erosion, dust, loss of strength when saturated, and shrinking and swelling with changes in moisture content. These are issues which are readily managed through effective planning, design and the implementation of environmental management procedures during construction and operation.

A preliminary assessment of the study area undertaken in 2005 identified potential contamination issues which might present a risk. Further investigations into site contamination will be undertaken during design. Where necessary, appropriate management or remediation measures will be undertaken prior to, or during construction.

Mitigation and management measures for controlling impacts associated with acid sulphate soils will be developed in accordance with the *Acid Sulphate Soil Manual* (Stone, Ahern and Blunden 1998), should any issues be encountered. The risk of encountering acid sulphate soils or potential acid sulphate soils on the new Expressway route is considered low.

The storage and handling of any hazardous substances and dangerous goods associated with project construction issues will comply with relevant Australian Standards, which provide guidance on these issues.