14 Public health

This chapter outlines the public health issues associated with the proposed development and the management measures proposed to mitigate potential adverse impacts. The two main issues are mosquito borne diseases that occur in the East Kimberley and farm chemicals in the environment.

14.1 MOSQUITO-BORNE DISEASES

14.1.1 Background

Ecological changes brought about by dam construction and irrigation area development in tropical regions around the world have been shown to be associated with an increased incidence of diseases such as malaria, filariasis, schistosomiasis, and those caused by arboviruses (Stanley 1972). Of these the most important to human health in north-west Australia are the arboviruses (Mackenzie and Broom 1999).

More than sixty-five arboviruses have been isolated in tropical Australia. Relatively few are human pathogens, and even fewer are of major concern. The viruses that cause, or have caused, significant human disease in Australia are the flaviviruses, dengue viruses and alphavirus groups (Mackenzie 1998). The significant viruses that occur within these groups are presented in Table 14.1.

Table 14.1 Significant arbovirus groups in Australia

Arbovirus group	Virus name
Flaviviruses	Murray Valley encephalitis virus, Kunjin virus and Japanese encephalitis virus
Dengue viruses	Virus types 1, 2 and 3
Alphaviruses	Ross River virus and Barmah forest virus

The flavivirus, which causes Murray Valley encephalitis, and the alphavirus, which causes Ross River virus, are the two most important pathogenic arboviruses causing human disease in Australia. Both are enzootic (always present) in the east Kimberley. Barmah forest virus has also been recorded in the Ord River area. The mosquito *Culex annulirostris* is an important vector of both the Murray Valley encephalitis virus and the Ross River virus. *Culex annulirostris* breeds in fresh water and is the predominant species of mosquito found in the Ord River area.

Murray Valley encephalitis virus

Epidemics of Murray Valley encephalitis occurred in eastern Australia between 1917 and 1925; over 280 cases were reported with a fatality rate of 68%. The most recent epidemic occurred in 1974, at which time the disease was renamed Australian encephalitis. Since 1974 all reported cases of Australian encephalitis have been confined to northern, and particularly north-western, Australia. The Kimberley region of Western Australia contains the only known confirmed enzootic foci of Murray Valley encephalitis virus activity (Mackenzie and Broom 1999).

Australian encephalitis is potentially fatal. The Murray Valley encephalitis virus is recognised as the main aetiological agent of Australian encephalitis, although a few cases are caused by the closely related Kunjin virus (Mackenzie and Broom 1999). There appears to be a correlation between the occurrence of the virus and the density of waterbirds and the predominant mosquito *Culex annulirostris*. Early studies investigating the ecology of the virus demonstrated that mosquito density and bird numbers had increased since the establishment of ORIA Stage One (Stanley 1972).

Increasing numbers of Australian encephalitis cases have occurred in Western Australia and the Northern Territory since 1977. Of the cases reported in Australia since 1977, thirty of the forty-eight have been from Western Australia, with a further thirteen from the Northern Territory. Many of the cases in Western Australia have occurred in areas distant from the Ord River, and of particular significance was the occasional spread of Murray Valley encephalitis virus from the Kimberley to the Pilbara and Gascoyne regions. It is hypothesised that the movement to the Pilbara was due to increased viral activity following heavy rainfall and the movement of waterbirds (Mackenzie and Broom 1999).

Ross River virus

The disease caused by Ross River virus is much more common than Australian encephalitis. Although it is debilitating, it is fortunately not fatal to its victims. However, the symptoms can persist for many months or even years. Ross River virus is one of the most frequently isolated arboviruses in Australia and has been obtained from more than thirty species of mosquito in six genera. Recently, the north-east Kimberley region was identified as having the highest case attack rate of Ross River virus in Australia (Broom and Lindsay 1998).

The average number of cases that have been reported nationally each year is approximately 4,800, with a maximum of 7,802 in 1996 and minimum of 2,602 in 1995 (Mackenzie 1998).

Recent research findings of Ross River virus in male mosquitos of the genus *Aedes* suggest vertical transmission to subsequent generations of mosquito via desiccation-resistant eggs. This provides a mechanism by which the virus can persist for long periods in the environment and would explain the rapid onset of cases following heavy cyclonic rainfall and flooding in arid regions. Recent evidence suggests that mammals such as western grey kangaroos and horses are the major vertebrate hosts and that birds are not involved in Ross River virus ecology. However, arbovirus transmission cycles are complex and relatively poorly understood in Australia (Mackenzie 1998).

14.1.2 Monitoring for mosquito-borne diseases

Since 1972 the Arbovirus Surveillance Laboratory at the University of Western Australia has been monitoring mosquito populations in the Kimberley region. These field sampling studies have become increasingly important as Australian encephalitis cases have become more frequent. Improved mosquito collection practices have been developed during these studies together with a more effective surveillance system to provide an early warning of increased virus activity.

In 1981 a sentinel chicken surveillance flock was established and by 1989 the number of flocks had increased to twenty-four in twenty-two regional centres in the Kimberley, Pilbara and Gascoyne. Similar sentinel programmes were established in 1992 in the Northern Territory. These programmes have shown that Murray Valley encephalitis virus is enzootic in several areas of the Kimberley, particularly in the Ord River area at Kununurra (Broom et al. 1998; Aldred et al. 1992; Mackenzie et al. 1992).

Since 1978, mosquito trapping has been undertaken in the east Kimberley at the end of each wet season. The results of this trapping show that, regardless of the area, *Culex annulirostris* dominates after widespread rain and flooding. Other floodplain-breeding species such as *Aedes normanensis* may dominate initially if rainfall is more localised. The numbers of mosquitoes vary widely from year to year but the highest numbers correspond to years with heavy wet season rainfall (Broom et al. 1995).

The Murray Valley encephalitis virus has been isolated every year in significant numbers of adult mosquitoes and there is a strong correlation between the number of virus isolates in any given year and the prevailing environmental conditions. Although most Murray Valley encephalitis virus isolates were obtained from *Culex annulirostris* mosquitoes, occasional isolates were also obtained from a variety of other species.

Researchers derived the following conclusions from the circumstantial evidence provided by the results of monitoring conducted to date in and around Kununurra:

- Damming of the Ord River and development of ORIA Stage One has attracted increased waterbird populations and provide additional mosquito-breeding habitats that would be conducive to increased arbovirus activity (Stanley 1972; Mackenzie and Broom 1999).
- More *Culex annulirostris* mosquitoes are present within the irrigation area at the end of the dry season than in the surrounding areas.
- Virus activity usually occurs in the Ord River region before activity elsewhere in the Kimberley.
- Results from studies at locations in the Kimberley such as Billiluna and Halls Creek suggest that Murray Valley encephalitis virus is epizootic (temporarily prevalent) in many areas of the Kimberley. It is also likely that the virus was also epizootic in and around Kununurra prior to the development of ORIA Stage One (Mackenzie and Broom 1999).
- The development of ORIA Stage One has created conditions suitable for other exotic arboviruses such as Japanese encephalitis virus, and chikungunya virus and exotic mosquito vectors such as *Aedes albopictus* (Mackenzie and Broom 1999).

14.1.3 Management of impacts related to the Project

Management action would be taken in conjunction with the proposed development to reduce the risk of increased infection with arboviruses. These actions would concentrate upon the following activities:

- designing and operating the Project so as to reduce the potential for increased mosquito-breeding activity;

- implementing education programmes for the Project's construction and operational workforce on measures that could be taken to reduce their personal risk of infection;
- extending the existing monitoring programmes to cover the Project Area.

Design and operational features

A number of design and operational features would be incorporated into the Project that would either directly or indirectly reduce the potential for increased mosquito-breeding activity. These features would include the following:

- removing surface undulations (gilgai), laser levelling of farm units, and providing formalised drainage to large areas of black-soil plains that are currently inundated during the wet season. These measures should substantially reduce the number of natural mosquito-breeding areas within the Project Area;
- through design, ensuring that irrigation water supply channels are swift-flowing and that balancing storage dams are through-flowing to avoid areas of 'still' water;
- through the provision of an automated control system for the irrigation infrastructure, maintaining water levels in the irrigation channels over a narrow operating range, thereby avoiding periodic wetting of channel banks and the consequential formation of breeding habitat for some species of mosquito;
- maintaining the irrigation channels regularly and regulating storages to remove weeds that may be conducive to mosquito breeding;
- operating the irrigation tailwater return systems so that the tailwater storage dams are normally empty.

Education programmes

Education programmes would be developed to advise the Project's construction and operational workforce and their families on measures they can take to reduce their risk of infection by arboviruses. The education programme would commence as part of the induction training provided to all new employees and would continue with ongoing awareness training.

The education programme would include the following:

- background information on the sentinel chicken programmes run in Western Australia and the Northern Territory and interpretation of the information made public from these programmes, including warnings of high arbovirus activity in the region;
- information on measures that can be undertaken to reduce the incidence of mosquito bites, including the wearing of appropriate clothing, the use of insect repellants and the reducing of outdoor activities at early morning and at dusk when mosquito activity is at its highest;
- an awareness programme that would enable employees to identify potential mosquito-breeding areas within the Project Area and to bring these to the attention of management so that remedial measures could be investigated.

Monitoring programmes

Monitoring of mosquitoes within the Project Area would be a component of the EMP that would be developed for the Project. At this stage it is anticipated that this would involve an extension of the surveillance monitoring programme currently undertaken in Kununurra. This would involve:

- sampling immediately after the first wet-season rains to investigate the activity of viruses in the region;
- monitoring mosquito fauna and virus-carrying rates in different years and at different times of the year;
- surveys of a range of mosquito and vertebrate host habitats;
- surveys of breeding patterns and density of vertebrate hosts, and monitoring infection rates of these hosts with viruses;
- conducting surveys of mosquito larvae in newly constructed irrigation areas.

14.2 FARM CHEMICALS IN THE ENVIRONMENT

14.2.1 Overview

The development of modern farming practices around the world has been associated with an increased use of agricultural chemicals. In some instances the use of farm chemicals has led to conflicts with adjacent land users, particularly if there have been any concerns regarding possible health effects on the surrounding community from repeated exposure to these chemicals.

The public health issues associated with the use of agricultural chemicals in the Project Area would be mitigated by the lack of other intensive land uses nearby and by the dominance of sugarcane cultivation, which has minimal chemical requirements for successful growth. However, a number of management measures are proposed to manage the issue of farm chemicals and the environment, as discussed in the following sections.

14.2.2 Commonwealth, State and Territory controls

All chemicals that would be used within the Project Area are controlled by Commonwealth, State and Territory regulatory mechanisms. The Commonwealth role essentially consists of legislative controls to regulate the chemicals that can be used within the Commonwealth, and the preparation of material handling requirements and guidelines. The State and Territory roles consist of controls over chemical use, the setting of policy and the monitoring of standards (Schofield and Simpson 1996).

Commonwealth management measures

Perhaps the most significant Commonwealth role is that played by the NRA, which restricts and registers the use of chemicals within the Commonwealth and ensures that appropriate user instructions are available. The NRA is an independent statutory body which was established to ensure that chemicals are safe (e.g. with no unacceptable risks to humans, animals, the environment and trade with other nations) and effective when used according to the label directions. The primary functions of the NRA can be summarised as assessing, reviewing and registering chemical products (and their active ingredients) for use in Australia (Schofield and Simpson 1996).

The NRA's activities are undertaken through three programmes that allow it to conduct special reviews of specific concern, reduce the likelihood of chemicals adversely affecting trade, and ensure that currently registered chemicals continue to meet the necessary standards of safety and performance. These programmes are as follows:

- Ad Hoc Review Program
- Regulatory Review Program
- Existing Chemicals Review Program.

Environment Australia works with the NRA by conducting environmental hazard assessments of chemicals. Manufacturers provide information on the chemicals, and this is combined with data from other sources to establish the degree of environmental exposure, the toxicity of the chemical to flora and fauna, and the overall environmental hazard posed by the chemical. The EPA (Commonwealth) may also request additional data, trials, controls, label instructions and warnings to minimise the environmental risk of chemicals.

An example of the NRA's role in the management of chemical use in Australia is the recent review of endosulfan, which led to a number of new restrictions on its use. These restrictions are discussed in Section 2.3.1 and, in summary, require detailed records of use to be maintained, restriction of its use to people who have met specified training requirements, controls on the means of application, and withholding periods for products that have been treated with endosulfan. The NRA would also prevent many of the existing uses of endosulfan beyond 1999–2000 unless industry can convince the NRA that continued use would not pose an unnecessary risk to the environment, consumers and worker safety.

State and Territory management measures

Use of chemicals is also controlled by State and Territory Government legislation, policy and monitoring of standards. Controls over the use of chemicals under Western Australian legislation are implemented through the following legislation:

- *Aerial Spraying Control Act 1996*
- *Agricultural and Veterinary Chemicals (Western Australia) Act 1995*
- *Agriculture Act 1998*
- *Environmental Protection Act 1986*
- *Health Act 1911.*

Controls over the use of chemicals in the Northern Territory are achieved through the:

- *Agricultural and Veterinary Chemicals (Northern Territory) Act 1995*
- *Environmental Offences and Penalties Act 1996*
- *Public Health Act 1997.*

These Acts are implemented through the respective State and Territory Government departments for health, agriculture and environmental protection.

14.2.3 Industry management measures

Industry has recognised that, if strong bureaucratic regulatory involvement is to be avoided, self-management is necessary to minimise the impact of chemicals on the environment. Many industries have demonstrated a strong commitment to self-management and have established best-practice management measures through an ongoing process between industry, researchers, and regulators (Schofield and Simpson 1996).

Examples of the commitment shown by ORIA Stage One farmers to self-regulation include the adoption of an integrated pest management strategy and a spray calendar developed in conjunction with AGWEST (see Section 2.3.1), both of which are designed to minimise the need for chemical applications.

Industry accreditation organisations have also worked with researchers and regulators to develop best-practice management measures. For example, the Aerial Agricultural Association of Australia has a Pilots and Operators Manual that includes detailed information on parameters affecting aerial application of chemicals and the legislative requirements of each State as well as recommendations on application techniques, safety and material handling, and disposal of waste materials (Woods and Lisle 1988).

14.2.4 Management measures proposed for the Project

The use of agricultural chemicals within the Project Area would be minimal in relation to other agricultural industries in Australia. Sugarcane, the dominant crop proposed for the Project Area, has a low requirement for pesticides. Furthermore, the Project Area and its surrounds are characterised by sparse residential settlement. As a consequence of the above factors, the potential for detrimental impact from the usage of agricultural chemicals in the Project Area is considered low.

Any usage of chemicals within the Project Area would be in accordance with Commonwealth and State regulations and industry best practice. Furthermore, any plans for the establishment for residential accommodation within the Project Area, would be controlled through the statutory planning controls in Western Australian and the Northern Territory (Section 11.3.2). Discussions are currently underway with the MfP and the Department of Lands, Planning and Environment to establish the most effective means of controlling residential development within the Project Area. It is anticipated that these controls would be enacted via the Kununurra Town Planning Scheme, and the proposed planning scheme for the Northern Territory, and would take full cognisance of public health issues.

Management measures to minimise potential health impacts outside the Project Area would focus on the minimisation of chemical use and the control of the main transport mechanisms of chemicals, as described below.

Airborne transport of chemicals

In order to minimise the potential for spray drift, the application of any chemicals within the Project Area would be from tractor-drawn boom-sprays whenever possible, utilising technology that results in relatively large spray droplets being released close to the ground. Studies into spray drift due to the use of boom-sprays on the Darling Downs in Queensland, where drift into sensitive crops can be a significant problem, suggest that it should be possible to spray within a metre or two of a susceptible crop (Wylie 1997). At worst, with the boom-spray set low to the ground and under favourable wind conditions, drift is not likely to travel more than a boom-spray width downwind of the target zone (Wylie 1997).

In other circumstances, for example when ground or crop conditions prevent tractor access, it may be necessary to utilise aerial spraying. In these instances only operators who have successfully undertaken the pilot accreditation programme of the Aerial Agricultural Association of Australia would be utilised, and the timing and manner of application would be carefully chosen to minimise spray drift. Studies of spray drift from aerial spraying have shown that the drift can generally be limited to the target area, but United States Environmental Protection Agency modelling indicates that drift can sometimes extend up to 400 m downwind (Woods and Dorr 1997). Notwithstanding the results of the United States Environmental Protection Agency modelling, registration authorities in Britain require buffer zones of only 6 m for surface rigs and 250 m for aircraft, depending on the nature of the pesticide, the type of crop, and the application method (Woods and Dorr 1997).

Furthermore, a monitoring programme conducted at four sites around Coffs Harbour in New South Wales during the five-month banana-spraying season during 1995 detected only chemicals associated with domestic use and termite control and not those from the adjacent agricultural operations. The study concluded that 'even in a semi-rural town with nearby widespread use of agricultural chemicals, community exposure to pesticides in ambient air may largely relate to their non-agricultural use' (Woods and Dorr 1997).

The Project Area is well separated from existing residences. The only residential settlement currently within the Project Area is the Spirit Hills Station homestead, and this would be resumed as part of the proposed development. Outside the Project Area, the nearest existing settlement, the Maralum Aboriginal community, is over 5 km away (see Section 11.2). Furthermore, the main residential area of Kununurra is situated approximately 36 km to the south-west of the Project Area. Farm residences within ORIA Stage One are located closer to the Project Area but those would be well outside the expected range for spray drift from aerial application. It seems clear that existing residences would not be impacted by airborne chemical spray drift by virtue of their distance from the Project Area. The dominance of south-easterly winds throughout the year (see Section 13.1) would also direct any airborne chemicals away from the major settlement areas of Kununurra and ORIA Stage One, which are located to the south-west of the Project Area.

A test kit has been developed by the University of Queensland that allows a rapid assessment of the placement deposit patterns in the field following spray operations. This information can be used to calculate optimum flight lane separations or, if drift is of concern, to determine the extent of drift associated with the spraying operations (Woods and Dorr 1997). This kit, or an equivalent process, would be used by the proposed Environmental Management Entity (Chapter 16) to monitor spraying operations within the Project Area as part of the EMP to be developed for the Project.

Surface water transport of chemicals

The risk of transporting chemicals from the Project Area in surface water to adjacent areas would be minimised through the on-farm water management systems described in Chapter 5. Furthermore, future use of surface waters downstream of the Project Area for potable water supplies is considered unlikely.

Percolation of chemicals to groundwater

Percolation of chemicals to groundwater is a complex process that is not yet well understood in Australia (Schofield and Simpson 1996). However, experience in the agriculture industry in New South Wales suggests that chemical movement in groundwater within black soils is not significant due to low hydraulic conductivity and the chemical characteristics of the heavy clay soils (Edge 1996). The portion of the Project Area developed for farmland would be exclusively black soil, and as a consequence percolation of significant volumes of agricultural chemicals to the groundwater is considered unlikely.

The low pesticide requirements for sugarcane cultivation combined with the prevalence of heavy soils suggest that contamination of Project Area groundwater by agricultural chemicals is unlikely. Nonetheless, as an additional precaution, groundwater would be tested on a regular basis for all chemicals used in the Project Area to ensure compliance with national drinking water quality guidelines.