The environmental impact of ports: an Australian case study

By
Associate Professor Malcolm Tull
Murdoch Business School
Murdoch University
Western Australia 6150
Tel: (618) 9360 2481
Fax: (618) 9310 5004
Email: M. Tull@murdoch.edu.au

Introduction[1]

It is widely recognised that an efficient transport system- one that allows the economical movement of goods, resources and people- is vital for economic growth and globalisation.[1] During the 19th century improvements in transport and communications were major factors in the expansion of world trade and globalisation. In the 20th century the communications revolution continued with innovations such as the motor car, aeroplane, large bulk carriers, container ships and pipe lines for oil and gas. Improvements to road transport and the introduction of railways caused land transport costs to fall by about 90 percent from 1800 to 1910; the real cost of ocean shipping fell by over 80 percent between 1750 and 1990; by 1980 the real cost of airfreight had fallen by about 75 percent from its level in the late 1930s.[2] According to UNCTAD, the increased participation of developing countries in world trade "would not be possible without global shipping networks, port reforms and investments in transport infrastructure as well as trade and transport facilitation;" moreover, there exists "a virtuous cycle where better transport services lead to more trade, and more trade in turn helps to encourage improved transport services."[3] By the beginning of the 21st century the 'tyranny of distance', while perhaps not completely tamed, was greatly diminished.

In the latter half of the 20th century growing public concern about the environment led to rising interest in the long run impact of humans on the environment and the emergence of the new discipline of environmental history. A greener generation of historians recognised that "transport systems, although critical to the rise of civilizations, have carried significant environmental costs for global ecosystems for many millennia."[4] As transport activity has increased, so have its undesirable side effects including air pollution, noise pollution, CO_2 emissions, and congestion.[5] The creation and expansion of transport infrastructures like ports, roads, railways and airports has the potential to cause serious environmental damage.

Australia's large area and limited population has meant that transport has been of special importance in overcoming the 'tyranny of distance.[6] The cost of ocean transport is especially important as it affects the competitiveness of the country's exports and effectively providing a tariff wall for its manufacturing industry. As

Australia is an island nation, its ports serve as vital gateways and interfaces in the transport network. The amount of traffic through Australian ports increased from about 30.3 million tonnes in 1949-50 to 157.4 million tonnes in 1969-70 to 518.8 million tonnes in 1999-2000. Thus in the last half of the 20th century the scale of port activity increased seventeen fold, implying substantially increased pressure on the environment. However, there were major changes in the composition, technology and spatial location of port activity over this period so it cannot be assumed that there was a one-to-one relationship between the scale of port activity and environmental degradation. The mineral boom of the 1960s led to the development of specialised bulk handling ports in remote areas which spread the impact of port activity over a larger land area. By the late 1970s Port Hedland, for example, was transformed from a sleepy backwater to a major port handling forty million tonnes of cargo per annum, about forty times the level of the mid-1960s.

For many years Australian ports had a reputation for inefficiency, industrial militancy and restrictive practices, but in the 1980s deregulation of transport systems, labour market reforms and corporatisation and privatisation of port authorities led to major improvements in port efficiency.[7]

Surprisingly, in view of their potential impact on the environment, ports, unlike other sectors such as road transport, have received little attention from environmental historians. Tonizzi (2004) drew attention to the dearth of historical research on the environmental impact of ports.[8] Remarkably, while the recently published *Encyclopaedia of World Environmental History* includes an entry on transport, there is no discussion of transport infrastructure such as ports.[9] The standard works on Australia's environmental history by Bolton (1981), Dovers (1994, 2000) and Garden (2005) give relatively little attention to the impact of transport.[10]

Environmental history can, according to Dovers (2000), inform policy-making in three ways: first, by providing historical context (how did we get here); second, by providing 'ecological and human baselines' (what was the environment like in the past); and, third, lessons from experience, although he warns against expecting 'too much from history.'[11] While a historical perspective will not provide all the answers, it can help understand port/environment interactions and aid the development of environmentally sustainable port policies.

The aim of this paper is to undertake a case study of the Port of Fremantle as a first step in assessing the long run impact of Australian ports on the environment. The

paper begins by considering the general relationship between ports and the environment; second, it briefly outlines the history of the Port of Fremantle; third, it considers the environmental impact of the port; and, finally, some preliminary conclusions are presented.

Source: Australian Bureau of Transport and Regional Economics, *Australian Transport Statistics 2005* (Canberra, 2005).
http://www.btre.gov.au/statistics/general/trnstats05/ATS05.pdf.

Ports and the environment

It is generally agreed that as the total volume of transport activity has increased so have negative externalities like pollution and congestion. In effect, transport growth is 'coupled' with environmental damage.[12] Thus 'transport costs' do not necessarily include all the real costs that transport imposes on the economy.[13] There are, of course, positive externalities associated with transport growth such as increased regional growth and improved communications for isolated communities. It is unrealistic to expect transport to be completely "green" and the environmental costs of transport operations and industries such as ports have to be weighed against their considerable economic benefits.[14] Some environmental damage may be acceptable if transport activity generates positive net benefits to society.

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Transport industries generate significant environmental impacts such as pollution, noise and traffic congestion. Transport is a major user of energy and therefore generator of emissions. Australia produces more than four and a half times the world per capita average of transport-related emissions. The United States (over 6.5 times) Canada (5.5 times) and New Zealand (4 times) also have high levels of transport-related emissions.[15] In Australia, transport accounted for fourteen percent or seventy-seven kilotonnes of national greenhouse gas emissions in 2001, an increase of twenty-five percent from the level in 1990, although almost ninety percent of this was accounted for by road transport.[16]

While it is hard to disentangle sources of pollution, Table 1 suggests that sea transport generates the lowest level of greenhouse gas emissions *per tonne of freight handled.*

Table 1: Greenhouse gas emissions per tonne of freight moved
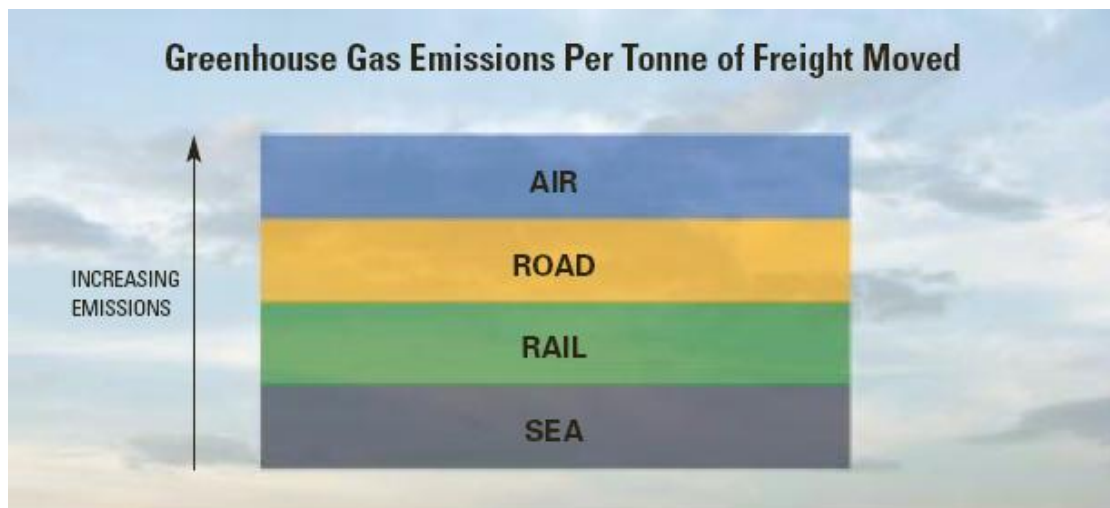
Source: South Australian Freight Council, *South Australia's freight transport infrastructure*, submission to Australian Government Infrastructure Taskforce, April 2005,
http://www.infrastructure.gov.au/submissions/SAFreightCouncil/Submission.pdf.
Accessed 7 June 2005.

A report on the North Sea found that of the six activities with the highest impact on the ecosystem shipping made up only one (anti-fouling substances), fisheries accounted for three (removal of target species, seabed disturbances and mortality of discards and by catch), and inputs from the land (organics and nutrients) accounted for two. [17] Thus, shipping transport appears to be relatively 'green'.

Specific impacts associated with shipping include oil spills, discharge of ballast water and other wastes and toxic chemicals from anti-fouling paints. The *Torrey Canyon*, a supertanker which was wrecked off the Southern English coast in 1967 with a cargo of 120,000 tonnes of oil, showed the devastating impact that oil spills can have on the local environment. The spillage of 20,000 tonnes of oil from the *Erika* onto the French coast in 1999 led to tighter EU environmental regulation and accelerated the phasing out of single hulled tankers.[18]

Fortunately, Australia has not experienced major pollution disasters but between 1982-1998 there were twenty-seven oil spills greater than ten tonnes in Australian waters.[19] For example, in July 1991, the Greek tanker *Kirki* lost its bow off the coast of Western Australia and about 17,280 tonnes of oil was spilled. Where oil spills have occurred in ports, such as the accident that led to the spill of 250 tonnes of oil from the *Laura D'Amato* in Sydney harbour in 1999, the port emergency procedures have usually ensured that they have been quickly contained. It has been estimated that about fifty-five species of fish and invertebrates and some seaweeds have been introduced to Australia by discharged ballast water.[20]

Over half a century ago, it was claimed that 'port and harbour works, being protective and local in effect, have a rare distinction among man's activities in changing the face of the earth; they are almost universally beneficial and it is seldom possible for their effect to be harmful.'[21] Environmentalists, who sometimes consider ports to be 'hot spots' of pollution, would not accept this sanguine view.[22] Specific impacts associated with ports include dredging and land reclamation, pollution, noise, smells, traffic congestion and hazards from the handling of dangerous goods.[23] In 2003, the top three environmental concerns of European port managers were garbage/port waste, dredging disposal and dredging.[24]

Dredging operations and the disposal of dredging wastes are one of the major sources of port-induced environmental damage. Dredging can destroy the habitats of marine species. Mud, silt and sediment dredged from channels or harbour bottoms is often highly polluted by hydrocarbons and heavy metals, although this pollution may not be the result of port operations but a legacy of land based agricultural, industrial and urban activities.[25] Many ports are located in or close to major cites which are themselves major sources of pollution. The development of specialised container and

bulk handling facilities with their 24 hour high-speed operations has increased noise and other pressures on the environment.

The proximity of ports and cities raises the possibility that accidents handling flammable or toxic cargoes could cause major loss of life and serious disruption to shipping and trade. In a horrific accident at the Canadian Port of Halifax in December 1917, a ship carrying a full cargo of explosives collided with another vessel and blew up. The massive explosion instantly killed 1,600 people, injured more than 9,000 and left 25,000 homeless. It was reputedly the largest man made explosion in history until the detonation of the first atomic bomb. [26] In April 1947 two ships loaded with ammonium nitrate exploded in Texas City, a port on the Gulf of Mexico. The explosions left 568 dead, over 3,500 injured and caused enormous damage to the port and surrounding city.[27] Of course, there has been over half a century of learning since these events, which has led to the introduction of safety standards to reduce this risk. Serious damage has been inflicted on port cities during wartime. Aware of community concerns about the environment, today navies including the Royal Australian Navy, place emphasis on environmental compliance and the development of environmentally 'sustainable' warships.[28] Since 9 November 2001 there has been concern about the potential damage that could be caused by terrorists if a ship was deliberately blown up in a port located close to a densely populated city. In 2002 the International Maritime Organisation introduced an International Ship and Port Facility Security Code in an attempt to improve maritime security.

Another problem both for the environment and ports is that the expansion of industrial, commercial and residential development has led to increased 'competition' between port and cities for land use. In many port cities the relative importance of maritime activity fell over time as other industrial and service activities grew in importance. By the late 19th century Hamburg, for example, while still a major port had become 'the hub of commercial enterprise throughout Germany' and its expansion and was increasingly driven by service enterprises which competed with the port for scarce urban land.[29] After the Second World War, ports were required to provide adequate depths and space for large bulk carriers and tankers and extensive

land areas for container terminals- requirements not easily met in cramped metropolitan ports.

Many ports were eventually forced to break out of their metropolitan straitjackets and develop new port areas, sometimes with mixed success.[30] In Sydney, for example, in the 1970s a second port was developed at Botany Bay, only about ten kilometres south of the city centre. The port's policy was to spread the impact of port activity across the urban area so that 'each affected community suffers a little but not to such a degree as to be totally intolerant of port and related activity.'[31] However, according to one assessment, port planning was poorly integrated with city development and environmental impact inquiries were held only 'as last ditch confrontations with affected city populations' and were 'totally inadequate.'[32] In 2004, a commission of inquiry was set up into controversial proposals to more than double Port Botany's capacity.[33] There was strong opposition from local councils, community groups and residents who stressed that port expansion, airport operations, traffic growth and management of the Bay 'are inextricably linked and that this demands an holistic approach to planning.'[34] The Commission concluded that the desired container throughput capacity of 3.2 million TEUs per year could be achieved with a smaller expansion than that proposed by Sydney Ports Corporation. This had the advantage of minimising adverse impacts on the five key values that captured the essential characteristics of Botany Bay: 'people and lifestyles, biodiversity and natural systems, economic importance, place in history, and Bay-side character.' [35]

Globalisation has increased pressure to lower transport costs and improve service levels. One outcome has been a move away from a mode-specific world to intermodalism, which is "the use of at least two different modes of transport in an integrated manner in a door-to-door transport chain."[36] Thus ports are viewed not in isolation but as key interfaces in global and domestic logistics chains. However, the implementation of intermodalism is both complex (especially with fragmented government and private ownership of transport infrastructure and equipment) and costly, with the benefits widely dispersed across a large number of users and existing

pricing systems not adequately allowing for cost recovery.[37] The 'Cost 340' project on the history of trans-European connections and internodal transport has attempted to cast light on why intermodal connections take so long to develop. [38]

In 2000 the British government released a sustainable distribution policy which reduced the emphasis on privatisation, competition and deregulation in favour of sustainability, intermodal integration, environmental protection and better regional and local planning. One effect of this is to favour maritime transport and especially ports with good land transport connections. An important strategy is to increase the proportion of cargo carried overland by rail in order to reduce congestion on metropolitan road networks. [39] Rail, however, is best suited to carrying cargo over long distances rather than short hauls so this may limit its use at some ports. A high proportion of container movements at Australian capital city ports, for example, are over a relatively short distance which favours road transport; they do not use two to three kilometre long trains double stacked with containers like those that travel daily between Los Angeles and the Midwest of the USA.[40]

All these issues have immensely increased the complexity of port management, which now has to balance port and broader community interests. The main aim of port managers was to provide a high quality service to users- primarily shipping companies, stevedores and importers- and not manage the environment. Traditionally, their approach to port development focussed on technological optimisation and treated the port as a 'stand-alone' structure, rather than as part of a larger interdependent coastal ecosystem.[41] Until the 1970s concern for the environment was often limited to environmental impact assessments taken after development plans were formulated, a process that did not necessarily result in sustainable port development policies.[42] Since then, under pressure from government legislation and local communities, ports in developed economies have gradually ensured that environmental considerations are better integrated into the planning cycle. Since the 1990s, there has been an increasing emphasis on triple bottom line approaches to economic, environmental and social issues.[43] In 1999 a series of guidelines on environmental management were developed for British ports.[44] The European Commission's Ecoports project, which was

completed in 2005, has provided a unified approach to the environmental management of ports via training programmes and by encouraging cooperative efforts to deal with environmental problems. [45] One outcome is a self diagnosis tool which helps managers evaluate the status of a port's environmental management. [46]

Because of the more stringent environmental regulations, ports have faced increased costs in a variety of areas including planning and design, operating expenses, intergovernmental and community negotiation and opportunity costs of lost revenues from planning delays. [47] In economic terms, ports have been increasingly required to internalise the external costs of port development.

Port planning is complicated by the fact that the powers of port authorities are usually limited to the immediate port areas and they have no control over metropolitan development. The provision of land transport links, for example, depends on the joint efforts of different public and private agencies, each with differing and possibly conflicting interests and responsibilities. Due to the complexity of modern port management, it is hard not to sympathise with the Los Angeles Harbour Commissioners who in 1973 complained that their port, "must serve a worldwide manufacturing and shipping boom, an energy crisis, an ecological renaissance…all in the same decade." [48]

Map of the Port of Fremantle
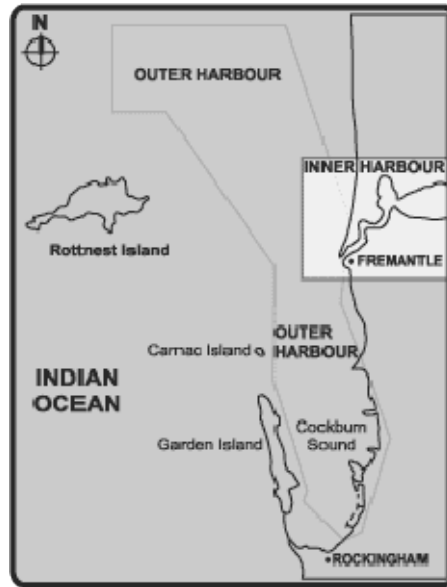
Map of the Inner Harbour
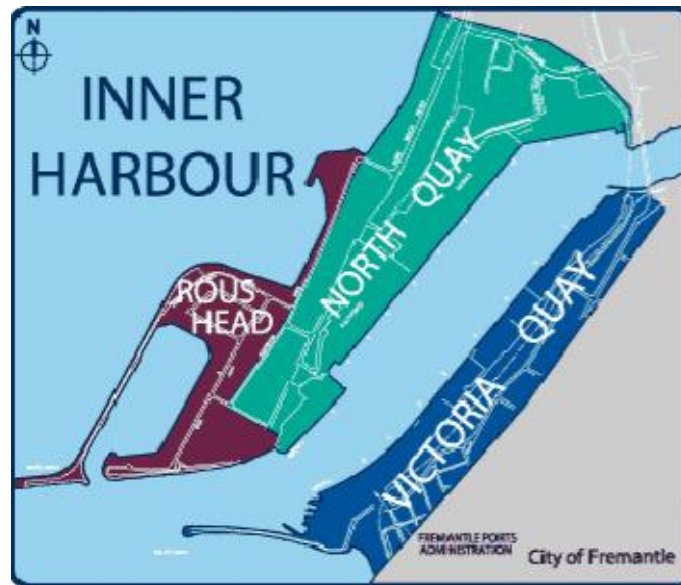
Source: FPA website.

History of the Port of Fremantle

The Port of Fremantle, which is located on the eastern edge of the Indian Ocean, was established in 1829 to provide the British with a gateway to the western part of the vast Australian continent. [49] In its early years Fremantle was far from an ideal location for a port because a rock bar blocked the mouth of the Swan River and ships had to use a few exposed wooden jetties. The colony struggled in its early years, which was reflected in the low level of port activity: the average number of vessels rarely exceeded seventy per year until the 1890s. The provision of an adequate harbour had to wait until the 1890s when the gold rushes transformed the economy and provided the revenues for large public infrastructure projects. By 1897 the rock bar had been removed, two moles built at the mouth, the harbour dredged to thirty feet (nine metres), and about 7000 feet (2100 metres) of timber wharves built equipped with cargo sheds. The first ocean going vessel to enter the new harbour, the Blue Funnel Line's *Sultan* in May 1897, symbolized Western Australia's economic take-off and integration into the British Empire.

The completion of North Quay in 1916 brought the total length of wharfage to almost 10,000 feet (3000 metres), a level at which it remained for many years. Although there have been many changes in the Inner Harbour, including dredging to increase the depth and the mechanisation of cargo handling technology, its basic physical layout remains unchanged to this day.

Western Australia's population grew from 184,000 in 1901 to about half a million in the 1940s. By the 1990s the state's population had reached 1.5 million of who over seventy percent lived in the metropolitan area. As the city developed competition between port and metropolitan land use activities increased but it was less serious than in older port cities such as Sydney. [50]

A breakout from the confines of the Inner Harbour did not occur until the mid-1950's, when the state government, which wanted to accelerate industrialisation in Western Australia, funded the dredging of channels to provide access to a new deepwater port at Cockburn Sound about twenty kilometres south of Fremantle. Anglo-Iranian Petroleum (later known as B.P.) was offered inducements to establish an oil refinery at Kwinana on the shores of the Sound, which was completed in 1954. This led to large increases in imports of crude oil and exports of refined petroleum products. An iron and steel works (1954), an alumina refinery (1964), fertiliser plant (1969) and a

nickel refinery (1970) helped establish Kwinana as the states' industrial hub. Planning for the port was well integrated with overall metropolitan development and adequate access for land transport and space for industry was provided.

While the locus of port activity began to shift southwards, away from the Inner Harbour, it still retained the lion's share of the high valued general cargoes. In the late 1960s container handling facilities were constructed on the northern side of the Inner Harbour. A second container terminal was opened in 1983. Containerisation made the wharf cranes and cargo sheds on Victoria Quay obsolete and it and, to some extent, the City of Fremantle, acquired a 'decaying' image. In 1983, Alan Bond, one of Western Australia's most colourful and controversial entrepreneurs, succeeded in temporarily snatching the America's Cup from the clutches of the New York Yacht Club and the city was rejuvenated in preparation for the defence of the Cup in 1987. Many port facilities on Victoria Quay were adapted for alternative uses including leisure activities and a museum.

In 1998-99 the total economic impact of the port was estimated at $728 million of which the Inner Harbour accounted for sixty-seven percent although it handled only eighteen percent of cargo tonnage; this was because they were the relatively high value container and general cargoes. The total employment impact of Inner Harbour and Outer Harbour operations was estimated at 3,896 and 1,896 jobs respectively, highlighting the economic importance of the port to the local economy. [51]

Despite some debate about the long-term viability of the Inner Harbour as a commercial port, the Fremantle Port Authority (FPA) has declared that it 'will continue in the longer term, throughout the twenty first century, as a major, dynamic container and general cargo port facility.'[52] Significantly, it is making plans for additional container facilities in the Outer Harbour.

Environmental impact of the Port of Fremantle

By world standards Fremantle is not a large port which limits the scale of the pressure on the environment. In 1903-04 it handled only 706,000 tonnes of cargo; in 1949-50 2.7 million tonnes; in 1969-70 12.8 million tonnes; and by 1999-2000 23.4 million tonnes. Therefore, in the latter half of the 20th century the scale of port activity and the implied pressure on the environment increased nine fold, compared to seventeen fold for Australia as a whole, although it should be noted that changes in trade composition and technology limit the accuracy of such comparisons. Until the mid

1950s, all cargo passed through the Inner Harbour; by 1999-2000, due to the diversion of bulk cargoes to the Outer Harbour, only about twenty percent did so. Thus the gradual shift of bulk cargoes to the Outer Harbour spread the impact of port activity over a larger geographical area. Cargo handled in the Inner Harbour per linear metre of wharf increased from 876 tonnes in 1949-50 to 1,441 tonnes in 1999-2000, an implied productivity increase of about sixty-four percent. This was mainly due to the mechanisation of general cargo handling (unitisation and later containerisation) and major waterfront reforms in the 1980s.

Table 2 provides an approximate summary of environmental pressures in the Swan River and Cockburn Sound since the 1850s. It is clear that the majority of pressure on the environment comes from sources other than the port. As we have seen, however, key impacts associated with ports include dredging, traffic congestion, pollution (including noise and smells), and the risks and hazards from the handling of dangerous ships and goods. Each will be considered in turn.

Table 2: Changes in environmental pressures in the Swan River and Cockburn Sound since the 1850s

1850s	1900s	1950s	2000s
Sewage	Sewage	Sewage	Sewage
Shipping and trade at exposed ocean jetties	Shipping and trade Inner Harbour (1897 onwards)	Shipping and trade Inner and Outer Harbours (1955 onwards)	Shipping and trade Inner and Outer Harbours
Fishing	Fishing	Fishing	Fishing and aquaculture
Forestry	Forestry	Forestry	
Agricultural runoff	Agricultural runoff	Agricultural runoff	Agricultural runoff
	Industrial effluents	Industrial effluents	Industrial effluents
	Urbanisation and urban runoff	Urbanisation and urban runoff	Urbanisation and urban runoff
		Petroleum	Petroleum
		Metals	Metals
		Synthetic organics	Synthetic organics
			Naval Base
		Recreational activities	Recreational activities

Source: Adapted from a table in J. H. Vandermeulen, 'Environmental trends of ports and harbours: implications for planning and management' *Maritime Policy and Management*, 1996, vol 23, No.1, p.59.

Dredging

Since the removal of the rock bar in the 1890s only minimal maintenance dredging has been required to maintain depths in the Inner Harbour which has helped limit pollution from this source. In 1916 the dredging of the depth from thirty feet (nine metres) to thirty-six feet (eleven metres) started but due to limited finances was not completed until the mid 1920s. By 1950s this depth was becoming a limiting factor for oil tankers and was one reason for the development of the Outer Harbour, which was provided with 12-metre access channels. The Inner Harbour remained at 11

metres until 1989 when the FPA increased the depth in the majority of the harbour from eleven to thirteen metres. The dredged material was used to provide reclaimed land for a new commercial boat harbour, known as Rous Head, on the northern side of the North Mole. In 1994 the FPA introduced the use of the Dynamic Under Keel Clearance System which enables the clearance between the bottom of the ship and the ocean floor to be predicted very accurately allowing ships to safely use the port with fuller cargo loads. Although originally developed for use in the Outer Harbour, it now enables larger and deeper draft (post Panamax) container vessels to squeeze into the river port.

Road and rail access

It is clear that the provision of adequate road and rail access is vital to the smooth functioning of the port. There is little point in making improvements to port facilities if the land transport system cannot cope with the increased cargo flows.

Until the development of containerisation, the majority of the port's road traffic went via Victoria Quay because North Quay specialised in bulk cargo that was normally transported by rail. When the Fremantle Harbour Trust (renamed the Fremantle Port Authority in 1964) was formed in 1903 it found Cliff Street, the main approach to Victoria Quay, was a congested and "highly dangerous thoroughfare". It was used by all types of city traffic and was criss-crossed by railway lines; every week between 4,000 and 5,000 vehicles travelled along the road to and from the port and about 600 lines of railway trucks were shunted backwards and forwards across the street. By 1905 it had been transformed into "a fine, straight, well-built roadway", with adequate lighting and a broad footpath for pedestrians. The relocation of the railway station in 1907 also improved access to Victoria Quay.[53]

Fremantle was provided with railway connections to the old sea jetty in 1891. The railway system, which was narrow gauge (three feet six inches), developed in two directions: northwards, via Perth, which was the major route, and southwards, via Robbs Jetty. The northward route crossed the Swan River immediately upstream of the port and connected with the Midland Railway at Midland Junction and, after 1917, provided a connection to the eastern states via the Trans-Continental Railway. However, rail access between Victoria Quay and the North Quay was via the main line only and both the mainline and the port system operated in a restricted land area behind the wharves: the system grew "up over half a century into a cramped lay-out, barely adequate to meet the trade of the moment, not capable of overload, and

inefficient in operation".[54] At the beginning of the 1970s the main line marshalling yards were transferred to South Fremantle releasing land for port uses on Victoria Quay.

In 2001/02 about ninety-seven percent of containers were handled by road and only three percent by rail. One train can carry the equivalent of seventy-ninety trucks and so greater use of rail has great potential to reduce pressure on the road system. However, the bulk of Fremantle's containers travel less than fifty kilometres and road transport has a comparative advantage over rail for short distances.[55] Nevertheless, the FPA aims to increase the proportion of containers handled by rail to thirty percent by 2010. To help achieve this, a new dual gauge rail loop line and terminal on North Quay was completed in March 2006.[56] The FPA estimates that land transport links will be adequate to cater for trade growth until at least the year 2020.

Pollution

Prior to the Second World War, pollution was probably less of a concern in Western Australia than in the more densely populated and heavily industrialised eastern states, but problems did arise from time to time. In 1912 there was opposition to further up-river expansion:

The city does not want it; the country, as much interested as the port or capital, would refuse assent to a scheme that would turn the waters of the banks into a wilderness of dingy wharves and factories, with perpetual volumes of smoke from shipping driving over the city.[57]

In 1928 the Minister for Public Works opposed development south of the river mouth on the grounds that it would spoil Fremantle as a seaside resort, turning it into "a mere mass of wharves and boats."[58] In the early 1950s there was renewed opposition from local councils to upriver port development due to fears of pollution. It was, however, claimed that the port had a negligible impact on overall pollution of the river.[59] The river has regularly suffered from algal blooms and other pollution problems caused by land clearing and fertiliser runoff in the catchment area. In the mid 1920s algae blooms in the marshy foreshore near the Causeway were used to justify dredging the river.[60] The Swan River Trust, which was set up in 1989 to protect the environments of the Swan and Canning rivers, in 2005 considered dredging as a solution to algae problems but there were concerns about the environmental side effects.

The Outer Harbour has also had an impact on the environment. An agreement made in 1971 between the government and Cockburn Cement Pty Ltd to remove sand

from the Parmelia and Success sandbanks for use in the manufacture of cement and lime proved controversial due to damage to seagrasses. In 1968 the Cockburn Sound Conservation Committee was established to advise on problems caused by pollution. In 1979, a controversial study by Dr Graham Chittleborough identified serious water quality problems in the Sound but these had little to with port operations.

The noise and smells associated with some port operations have also led to community concerns. Live sheep shipments, for example, have attracted some criticism over the years regarding the care of the animals and the smells emanating from the sheep carriers. However, improvements in carrying and feeding operations have led to high survival rates for the livestock and specialised vessels now service the trade. The FPA has considered moving the live sheep trade to the Outer Harbour but currently there are no suitable facilities available.

The FPA is, however, attempting to maintain high environmental standards and control pollution. In 1999 it launched an environmental policy statement and established an Environmental Awareness Team; it gained ISO 14001 certification (the international standard for environmental management) for its environmental system in 2001. The FPA is undertaking extensive community consultation regarding the development of new container and general cargo facilities in the Outer Harbour. Table 3 summarises the planning process.

Table 3: Planning process for the Outer Harbour

Overall Project Assessment Process
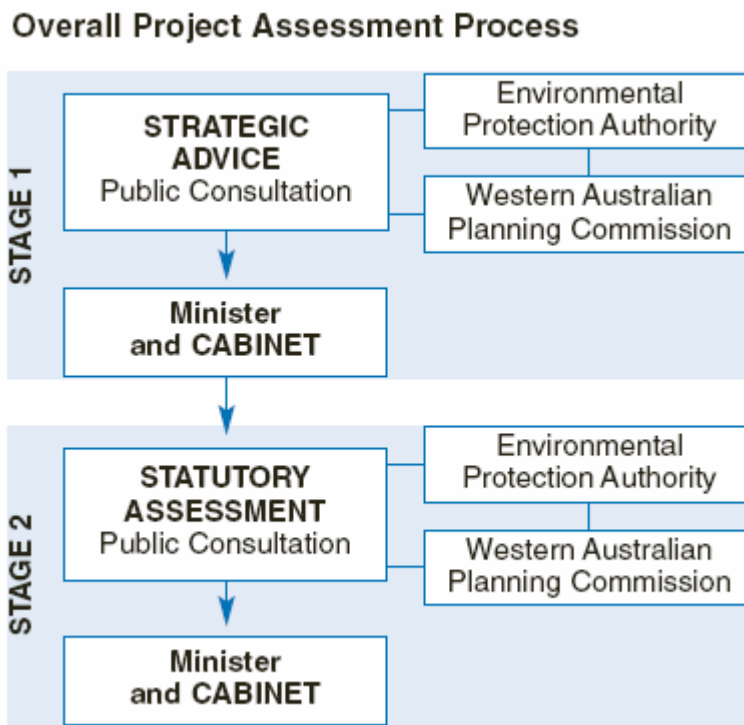
Source: Western Australian Planning Commission, *Fremantle Ports Outer Harbour Project Information Brochure* (Perth, 2004).

Environmental risks and hazards

There have, of course, always been risks with locating ports close to metropolitan areas. The advent of oil bunkering and bulk oil handling in the early 1920's led to concerns about the dangers of fire and water pollution. At that time there were no regulations or appliances to guard against oil spills. In 1918 the SS *Polgowan*, which was reputedly carrying sufficient TNT on board to blow up Fremantle, caught fire at the North Wharf but fortunately the ships' crew and the local fire brigade brought the fire under control. A serious fire on the *Panamanian* during the Second World War also highlighted the potentially hazardous nature of port operations. Wharf labourers were sometimes at risk from dangerous cargoes such as blue asbestos which as late as the 1960s were handled with procedures, which have since been found to be woefully inadequate.[61] Currently, the Dangerous Goods (Transport) (Dangerous Goods in Ports) Regulations 2001 set out detailed procedures for safety management systems and emergency response plans for dangerous cargo operations.

The opening of a naval base (Fleet Base West) on Garden Island in 1978 led to increased naval activity in the Outer Harbour. Fremantle receives regular visits by

foreign naval vessels, some of them nuclear powered, which poses risks to the environment as well as increasing the potential for terrorist attacks, although nuclear powered vessels do not enter the Inner Harbour. On the other hand, expenditure by crews from visiting US naval vessels in 1998/99 created additional economic output of twenty-two million dollars and 193 full-time equivalents jobs.[62] The *Australian Maritime Transport Security Act* 2003 has required all ports to have a port security plan approved by the Office of Transport Security and led to increased restrictions on access to the working areas of ports.

In recognition of the need to provide adequate separation between the working port and other urban uses the FPA commissioned a Buffer Definition Study (2001). [63] This led to the development of a three level buffer scheme to provide appropriate separation between port and non-port activities depending on the level of individual and societal risk; its main recommendations have been incorporated in town planning schemes.

Conclusions

There is a broad consensus that transport growth is 'coupled' with environmental damage and that the development of infrastructure such as ports has the potential to degrade the environment. Key impacts associated with ports include dredging, traffic congestion, pollution and the risks and hazards from the handling of dangerous ships and goods. Ports located in river estuaries may appear to be environmental 'hot spots' but a large part of the pollution is usually generated by upstream activities. Clearly, pressure on the environment comes from many sources, not just ports, and it may be more appropriate to view them as pollution 'check points' rather than 'hot spots'.[64] After the Second World War, many ports developed new port areas, a spatial shift which reduced environmental pressure at existing locations. It is hard, however, to imagine a truly 'green port' and, clearly, the environmental costs of port operations have to be weighed against the considerable economic benefits. All of these trends and pressures were apparent at the Port of Fremantle.

Until the Second World War the relatively small scale of port activity at Fremantle limited pressure on the environment and there is no clear evidence of serious port related environmental degradation. A breakout from the confines of the Inner Harbour was not necessary until the mid-1950s, when the port began to exploit the deep-water and extensive land areas of Cockburn Sound. Increased economic and port activity

led to negative environmental impacts especially in the Kwinana industrial zone but in the last two decades the FPA has endeavored to be a good corporate citizen and develop sound environmental management strategies. In 2005, it was awarded the Lloyds DCN Corporate Citizen Award. One simple measure of the success of its environmental management is the fact that dolphins can regularly be seen swimming in both the Inner and Outer Harbours. The Inner Harbour facilitates community enjoyment of the local environment and coastline with ferry access to the offshore tourist island of Rottnest and ocean access for yachts and other vessels from further up-river. The port is an important transport hub serving the needs of both industry and the community and the only place in Western Australia where rail, sea and land transport modes closely interlink.

There will, however, always be tensions over the environmental impact of port activities and the allocation of scarce resources such as waterfront land; successful port managers need to be responsive to community demands and educate the public on the value of the working port. A staff member of the Sydney Ports Corporation once wrote that

 A history-conscious community will see the value in preserving a working waterfront and will be unlikely to press for every metre of shoreline to be dedicated for urban waterfront projects.[65]

This is a lesson not lost on the FPA, which has helped to sponsor a major historical project called 'Voices from the West End'. This project aims to record and publicise the history of the West End of Fremantle, which until the latter part of the 20th century, was the heart of the working port.[66] While the focus of the West End of Victoria Quay is increasingly shifting to urban, educational and recreational activities, the FPA is keen that it also remains part of a working port well into the 21st century.

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