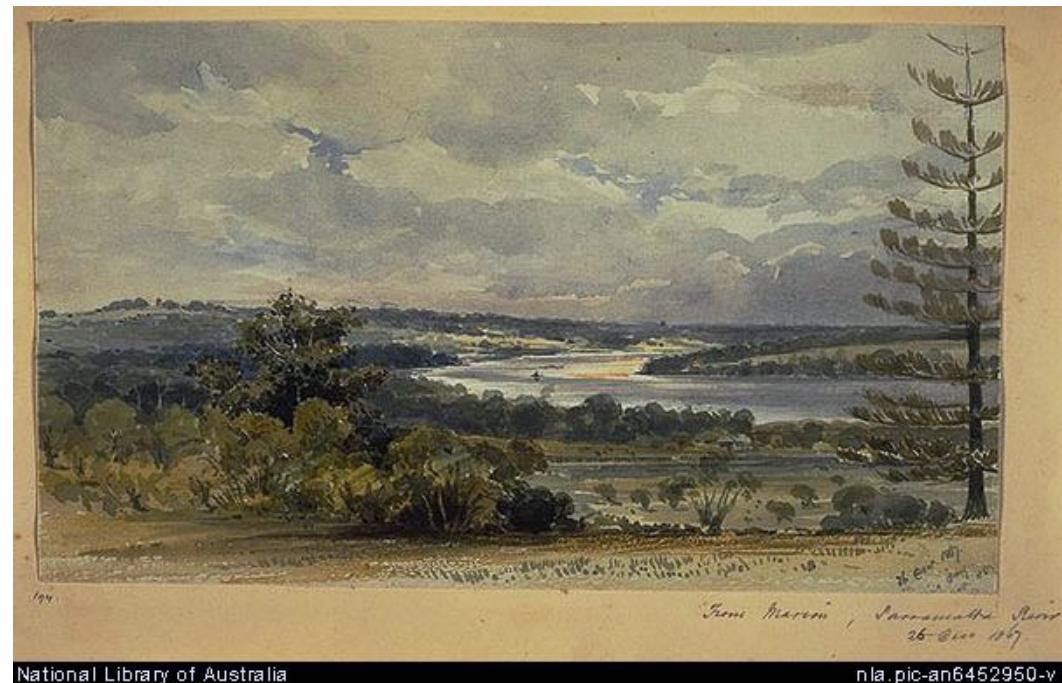


# ***PLENTY OF EELS: Industrial Activity, Environmental Quality and Ecological Restoration in the Parramatta River, Australia***

*Paul Goldsworthy, ENVIRON Australia  
Richard Wenning, ENVIRON International  
David Moore, ENVIRON International*

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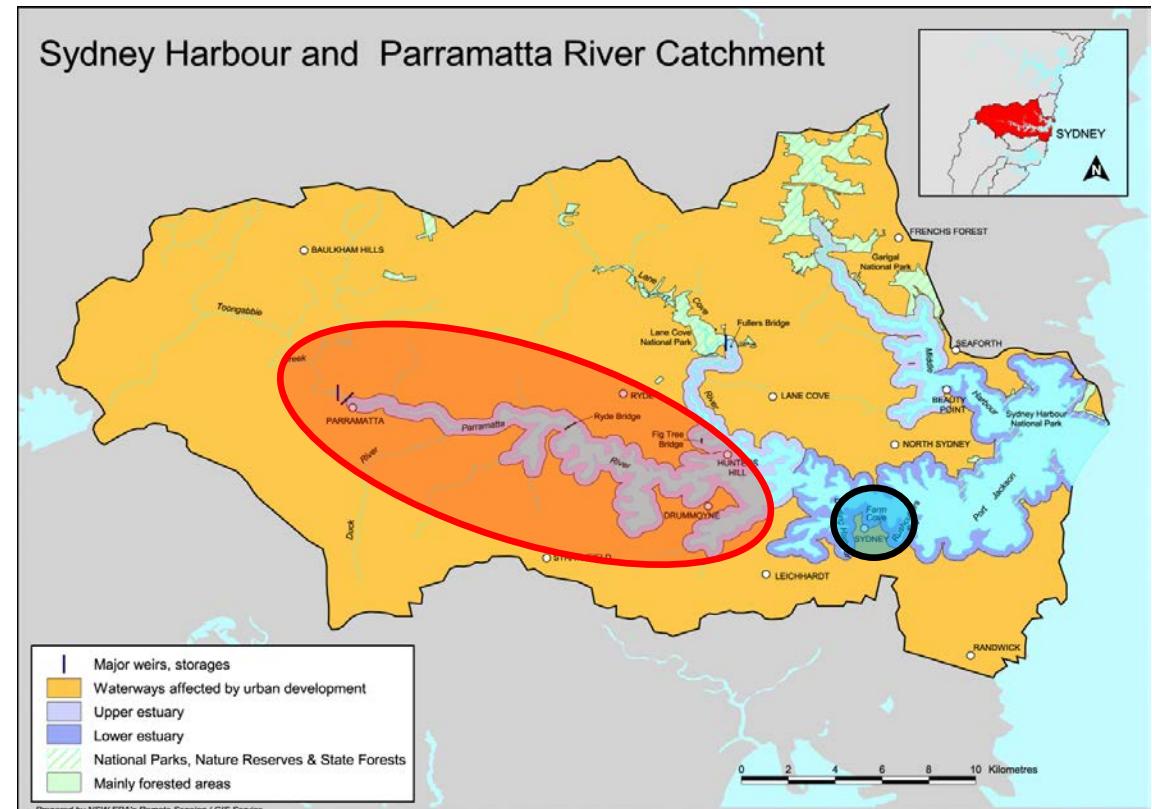
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# Background

## Parramatta River (*red ellipse on map*)

- Based on Aboriginal name “Burramatta” meaning “Plenty of Eels”
- Evidence for 20,000 years of Aboriginal occupation
- West of Sydney CBD (*black circle*)
- Area settled in 1788 for farming due to reliable freshwater
- Connected to Sydney Harbour (Port Jackson) and the Pacific Ocean
- Approximate total length of tidal reach is 18km (11 miles)
- Tidal flushing for complete water exchange takes 3-4 months



# Background

## *Industrial History*

- until 1970 the river was an open drain for Sydney's industry – tanneries, metal working, petroleum refineries, coal gasification, paints and chemical manufacturing
- southern central embayments are thus contaminated with a range of heavy metals and chemicals
- almost the entire tidal reach of the river is currently developed as either industrial or residential use
- more recently, some major industry has closed or relocated to alternative areas, thus enabling further residential development and driving the need for remediation and/or restoration



# Background

## *Recreational History*

- Prior to European settlement, the river was used for fishing and gathering by local Aboriginal groups
- Since European settlement, the river has been used as a reliable water source for agriculture and industry, for commercial fishing and for recreational activities such as fishing, boating and swimming
- Current river use includes rowing, sailing, transport (ferries) and recreational fishing (although not for human consumption)



# Background

## *Ecology*

- Native vegetation severely reduced and present in narrow corridors or isolated pockets
- Significant stands of mangroves, mainly at the head of embayments and along river banks in low energy environments
- Mangroves have colonised areas that were previously salt marsh - mangroves are more abundant now compared to arrival of Europeans (~220yrs ago) but to the detriment of more sensitive ecological communities, such as seagrass and saltmarsh
- Eels are still plentiful in some areas, but introduced species, particularly the European carp (*Cyprinus carpio*), are widespread and out-compete many native fish species
- Local extinction of some species, e.g. green sawfish (*Pristis zijsron*)



# Current Issues

## *Channelisation*

- More than 90% of river banks have been replaced with artificial structures – e.g. vertical sandstone block walls
- Bank erosion - e.g. vessel wakes and flooding - leads to further stabilisation and channelisation works

## *Contamination*

- Metals -cadmium, chromium, copper, lead, zinc
- Organics – hydrocarbons, PAHs, OCPs, dioxins
- Storm water
- Sediments

## *Reclamation*

- Many areas of the river, particularly the swampy heads of bays, have been reclaimed
- Often being used as rubbish dumps before being converted into sports fields



# Current Issues

## *Ecology*

- Excessive siltation of the river is an ongoing problem
- Land clearing and development has allowed soil and various nutrients to be washed into the river, promoting expansion of mangrove habitat
- Water quality fluctuates with tidal flushing whereas sediments act as a sink for contaminants and are the main eco (and human health) risk
- Habitat fragmentation – remnant pockets of ecology within an artificial landscape
- Extinction of some species, e.g. green sawfish
- Endangered plant and animal species, e.g. green and golden bell frog (*Litoria aurea*)

## *Invasive Species*

- Alligator weed (*Alternanthera philoxeroides*)
- Various terrestrial weeds and feral animals, e.g. rats and mice
- Carp



# Remediation

- Assessment and remediation of aquatic and terrestrial environments is recognised as the first step in restoring degraded areas of the Parramatta River
- To date, remediation activities have targeted several high profile sites:
  - near the former Union Carbide plant at Homebush (dioxins) [*Case Study 1*]
  - near the former Berger paints plant at Rhodes (lead)
- While planning for remediation of other areas is currently underway:
  - near the former coal gasification plant at Kendall Bay (PAHs) [*Case Study 2*]



# Restoration

- The restoration of ecological form and function along the Parramatta River is being driven by a number of issues –
  - Local community pressure to improve environmental health
  - Recognition of human health (and ecological) risk from degraded environments
  - A growing need for more recreational space
  - Dwindling land available for residential developments and the need to incorporate green space within new development proposals
- Restoration is being undertaken in a variety of ways –
  - Local, State or Commonwealth funding
  - Local community volunteer groups
  - Industry driven – legacy issues



# Case Study 1: Homebush Bay

- Site of the 2000 Sydney Olympic Games
- Homebush Bay area was used for a range of industrial activities up until the 1990s, including:
  - state brickworks
  - abattoir
  - naval armaments depot
  - manufacture of pesticides (i.e. 2,4-D, 2,4,5-T, DDT)
  - manufacture of other chemicals, paints, plastics and industrial alcohols



# Case Study 1: Homebush Bay

## ***Remediation:***

- Approximately 160-hectares containing wastes including power station ash, demolition rubble, asbestos, industrial hydrocarbons, domestic garbage, and dredging material from the Parramatta River
- Between 1992 and 2000, the NSW Government allocated \$137 million for remedial action to clean up polluted areas
- The remediation policy at the time was to safely contain and where possible treat, waste on site, rather than relocating it to other places
- About 9 million cubic metres of waste were recovered, consolidated and contained (the largest remediation project in Australia)
- Approximately 400 tonnes of soil contaminated with hydrocarbons and classified under environmental legislation as scheduled chemical waste was treated in a two-stage thermal desorption process
- The majority of the buried waste was removed and relocated to designated waste containment mounds which were capped, landscaped and turned into parkland
- Leachate collection and transfer systems were built to prevent leachate from escaping into the environment

[[www.sopa.nsw.gov.au](http://www.sopa.nsw.gov.au)]

# Case Study 1: Homebush Bay

## *Ecological Restoration:*

Aim was to rebuild functional naturalistic ecosystems within an urban parkland environment and involved:

- remediation of 160 hectares of contaminated land and the recovery, consolidation and on-site containment of nine million cubic metres of excavated waste
- restoration works to 100 hectares of remnant estuarine wetlands and 20 hectares of remnant eucalypt forest
- dechannelisation of 2km of estuarine creek line, converting it from a concrete stormwater drainage channel into a naturalistic tidal waterway edged by saltmarsh terraces
- restoration of tidal flushing to a 35 hectare land-locked estuarine wetland
- construction of new wetland, grassland, woodland and saltmarsh landscapes on remediated lands, with over eight million seedlings planted on both salvaged and constructed topsoils
- design, construction and establishment of new habitats for target flora and fauna communities, particularly the endangered Green and Golden Bell Frog and the endangered Coastal Saltmarsh community. A network of seventy frog ponds were built over 90 hectares of land and linked by movement corridors and road underpasses
- Saltmarsh terraces were built to provide additional saltmarsh habitat

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# Case Study 1: Homebush Bay

## *Success Factors:*

- improved condition of the habitats and enriched biodiversity
- habitats support three endangered ecological communities, protected marine vegetation, over 180 species of birds, 7 species of frogs, 10 species of bats, 10 species of reptiles, many species of native fish, and thousands of invertebrate species
- original Green and Golden Bell Frog population has been conserved and two new satellite populations established on remediated lands
- Coastal Saltmarsh has increased in extent from 20 hectares (2002) to 25 hectares (2007)
- Migratory shorebirds have returned to feed and roost at the Waterbird Refuge



# Case Study 1: Homebush Bay

## ***Drivers:***

- The main driver for the remediation and subsequent ecological restoration at Homebush was the Sydney Olympic Games in 2000
- Potential for international scrutiny
- In addition, local community groups actively campaigned for action
- Government agencies provided funding, support and direction

## ***Associated Issues:***

- Mobilisation of dioxins from sediments at Homebush have led to a fish consumption ban for all areas of the Parramatta River and Sydney Harbour west of the Harbour Bridge
- Commercial fishing ban has been in place within Sydney Harbour since 2006



# Case Study 2: Kendall Bay

- Sediments adjacent to a former coal gasification plant
- Land redevelopment already undertaken – residential community
- Sediments mainly contaminated with PAHs (coal residue)
- Human health and ecological risks identified
- Human health risks (especially to children playing in the water) have driven the need for remediation
- Various remediation options are under consideration
- Funded by company who inherited the site

## ***Driver:***

- Reduce ongoing liability risk for legacy site



# Conclusions

- The Parramatta River consists of a heavily impacted and degraded estuarine environment
- More than 200 years of industrial activity and urban pressures are apparent in the water and sediment quality and loss of native habitat
- Remediation and restoration is slowly being undertaken but the drivers are not consistent
- The biggest drivers to date have been potential global scrutiny (via Sydney Olympic Games) and the desire of industry to clear future legacy issues
- Remediation and restoration is therefore unstructured
- Actions typically occur if unacceptable risks are identified during redevelopment of previous industrial sites

***A more structured approach to remediation and restoration is required if the ecological function and human use value of the Parramatta River and surrounding areas is to be improved***

