STATE GOVERNMENT OF WESTERN AUSTRALIA

SWAN RIVER TRUST

Swan River Trust

20 NOVEMBER 2009

Report to
Hon Donna Faragher
JP MLC

MINISTER FOR
ENVIRONMENT;
YOUTH

SITUATION REPORT

Dolphin deaths in the Swan Canning Riverpark

Caring for the Swan Canning Riverpark

ACKNOWLEDGEMENTS

This report was prepared by officers of the Swan River Trust (Trust) with contributions from representatives of the departments of Environment and Conservation, Water, Health and Fisheries and researchers from the universities of Murdoch and Curtin.

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ACRONYMS

DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEC	Department of Environment and Conservation
DoW	Department of Water
ICMS	Incident Complaint Management System
NNCP	Non-nutrient Contaminant Program
OC	organochlorine
PAH	Polycyclic Aromatic Hydrocarbons
PCB	poly chlorinated biphenyl
PRNRM	Perth Region NRM
SCRIP	Swan Canning Research and Innovation Program
TBT	Tributyltin
TSS	Total Suspended Solids

DISCLAIMER

The information in this report has been drawn from a range of resources and for the ease of reading the source of this document has not been extensively referenced.

1 INTRODUCTION

Following the deaths of six dolphins in the Swan Canning Riverpark, the Minister for Environment; Youth requested a report by 20 November 2009 outlining the research, ongoing monitoring and further actions being undertaken by the Trust, other government agencies, researchers and experts. This Situation Report is in response to this request.

2 SUMMARY OF INFORMATION TO DATE

2.1 Dolphins

2.1.1 Statistics on dolphin deaths and necropsy results

Between June and October 2009 there were six recorded dolphin deaths in the Swan Canning Riverpark. These are summarized in Table 1. Further information on the dolphin necropsy results is provided at Attachment 1.

Table 1: Summary of dolphin deaths in Swan Canning Riverpark in 2009.

No	Date	Sex/age	Location	Notes	Post-mortem	Contaminant testing
1	5 June 2009	Male calf ~2 years	Near Chidley Point	No obvious injury or disease - advanced de-composition	Murdoch Uni – inconclusive	complete
2	8 June 2009	Male 2-2.5 years	Mosman Bay – Coombe reserve	No obvious injury or disease - advanced de-composition	Murdoch Uni – Infection of the brain associated with *Aspergillus sp.* fungus (opportunistic pathogen); no gut contents, focal area of intestinal haemorrhage/infarction (significance unknown), individual may have prior immuno-suppression	complete
3	21 June 2009	Female Juvenile-subadult	Near Belmont ski area	Fluke entangled with fishing line causing extensive soft tissue scarring and inflammation	Murdoch Uni – multi organ infection of *Staphylococcus aureus* (golden staph) bacterial infection; due to probable septicaemia; pneumonia; likely that this individual succumbed to infection introduced through the wounds in the fluke; pre-existing immunosuppression cannot be ruled out	complete
4	17 September 2009	Female adult (old)	Foreshore between Claise-brook Cove and Windan Bridge	Believed to be sick dolphin sighted from 14 September - covered in skin lesions	Perth Zoo/Ag Dept. Severe fungal dermatitis, possibly immuno- compromised	pending

5	9 October 2009	male	Freshwater Bay	Very decomposed - teeth and blubber samples taken and collected by Dr Hugh Finn	In consult with DEC and Dr Hugh Finn, no autopsy undertaken	Not possible
6	25 October 2009	Female adult	Near Applecross jetty	In poor body condition - covered in skin lesions, recent entanglement of the right pectoral fin, fish hook and line lodged in oesophagus	Murdoch Uni – likely drowned as a terminal event due to it being severely weakened by poor body condition and severe skin lesions, also had multi-organ infection by various opportunistic bacteria, indication of immuno-suppression	pending

2.1.2 Ecology of dolphins

A wide body of information has been gathered on the ecology and genetics of the Swan River dolphin population. Information on the status of this dolphin population and its broad ecology is provided in Attachment 2.

2.2 Contaminants

There is no evidence to date that contaminants in dolphins have directly caused their deaths. However, many contaminants are well-known as a cause of immuno-suppression in many mammals including dolphins, thus indirectly leading to their death through succumbing to secondary opportunistic infections. Moreover, many contaminants are also known to be carcinogenic and teratogenic. Researchers believe that the contaminants may be contributing to immuno-suppression, but there may also be other factors, such as dolphin morbillivirus that could also be responsible. Water quality and seasonal changes may also be important factors. It is important to stress that these potential aetiologies are not necessarily mutually exclusive, and they may be present concurrently, i.e. disease may be due to multi-factorial events/disease-causing agents. Disentangling these factors is a complex exercise and will require a significant level of investigation.

2.2.1 Contaminants in dolphins

To date the contaminant testing results are only available for the first three dead dolphins. Remaining results are pending. Contaminant testing on the three dolphins included organochlorines, PCBs, polycyclic aromatic hydrocarbons and metals. The results are still being evaluated and compared to other systems worldwide. Initial results suggest dieldrin levels in the dolphins are high on worldwide scale (ranged between 2.8 and 39µg/g lipid weight (lw), compared with global statistics of 0.13 to 1.29µg/g lw; Palmer pers comm., Law et al., 2006[1]).

Total PCB concentrations in the first three dead dolphins ranged between 10.6 and 53.9 µg PCB/g lw and in two cases exceeded the threshold level of 17µg PCB/g lw for adverse effects on the immune function of marine mammals (Kannan et al 2000[2]).

[1] Law et al. (2006). Collaborative UK Marin Mammals Strandings Project: Summary of Contaminant Data for the Period 1993-2001. Sci. Ser. Tech Rep., Cefas Lowestoft 131: 72pp.

[2] K. Kannan, A. L. Blankenship, P. D. Jones and J. P. Giesy. (2000). Toxicity Reference Values for the Toxic Effects of Polychlorinated Biphenyls to Aquatic Mammals
Human and Ecological Risk Assessment: Vol. 6, No. 1, pp. 181-201

The estimated threshold level for reproductive effects in marine mammals is 25 to 77µg PCB/ g lw (AMAP 2000[3]). Concentrations of DDE (a metabolite of DDT[4]) reported in the dolphins (8 to 82.9 µg/g lw) may be sufficient to cause physiological effects. Concentrations of zinc in the dolphins (120 to 160 mg/kg ww liver) compare with elevated levels reported in the literature. However it is difficult to assess if this is detrimental because zinc is an essential element. Methyl mercury and tributyltin were below the limit of reporting and further testing is required. Little is known about the cumulative impact of mixtures of contaminants on the health of marine mammals.

As part of collaboration between Murdoch University and the Swan River Trust which began earlier in 2008-09, tissue samples have been taken from three live dolphins and contaminant results are, on average lower for dieldrin, DDE and PCBs than that reported for the dead dolphins. However, researchers have indicated that tests on live dolphins may be an underestimate of contaminant levels due to the small sample (ie: not deep blubber) taken from a live animal without causing stress. It is also important to point out that the three individuals tested so far are juveniles/sub-adults and thus 'under-estimate' the potential contaminants problem in that they accumulate with time – so as they get older their levels are likely to get higher, particularly in males (females pass on a large proportion of contaminants to their calves, particularly the first-born; which is known to be a cause of mortality in affected calves).

2.2.2 Contaminants in fish

The Department of Health has a WA Food Monitoring Program that is investigating metal concentration in seafood in a range of aquatic environments around the State including the Swan River. To date results are not available and testing in that study was limited to metals. In November 2009 the Department of Fisheries collected 12 black bream from the Swan and Canning rivers and these were sent for analyses of organochlorines at the Chemistry Centre of WA. These were processed according to the standard food health protocol (ie viscera removed). Results show dieldrin in these fish at levels ranging from 0.015 to 0.061mg/kg. Three of the bream (caught in the Swan River) also had DDE values ranging from 0.018 to 0.053mg/kg.

These were lower than the food health guideline extraneous residue limit of 0.1mg/kg (dieldrin) and 1mg/kg (DDT)[5] and based on this evidence the Department of Health indicated that there was no risk to the public in eating finfish from the system. Given the limited number, size distribution and species tested for contaminants it would be pertinent to collect and test more fish from the Swan. The Department of Fisheries is initiating a further investigation of contaminants (organochlorines and PCBs) in a range of recreational species (to include where possible crabs, mullet, Perth herring and mature black bream) collected from a range of locations in the river. The extent of analysis of contaminants will be subject to additional funds being obtained. Samples should be tested according to the fish health protocol (ie viscera removed) in order for comparative information to be made to food health guidelines. However,

[3] AMAP (2000). AMAP Assessment report: Arctic pollution issues. Arctic Monitoring and Assessment Programme, Oslo, Norway.

[4] Usually the concentration of the various congeners of DDT are expressed as the sum of DDT ie sum p,p'-DDT, o,p'-DDT, p,p-DDE and DDD. However for the purposes of this report the authors have used the simplified DDT and DDE.

[5] The extraneous residue limit for DDT is normally compared to all DDT congeners. As only DDE was above detection limits, this was taken to represent the total DDT level and therefore compared with the guideline.

whole fish should also be tested to gain a broader understanding of the presence of contaminants in the food chain and more specifically what the dolphins may be being exposed to.

2.2.3 Information on the organic contaminant found in dolphins

Dieldrin is an insecticide that has been banned since 1988. A related product, aldrin (which may oxidise to form dieldrin), was banned in the mid 1990s. It was used widely to treat for termites and may have also been used to treat agricultural crops. Dieldrin continues to be present in the sediment of the Swan and Canning rivers with middle portions of the river showing greatest concentration (see section 2.2.5) suggesting that a likely source is urban stormwater. Contamination is likely to be historic, arising from groundwater contaminated by treatment of wooden poles, buildings and fences.

DDE is a metabolite of DDT (an insecticide) and is more resistant to degradation than its parent product. DDT has been banned in Australia since 1987.

PCBs are stable at high temperatures and so were used widely in transformers, capacitors, hydraulic fluids, fire retardants and building material. Importation of PCBs to Australia was banned in 1979. PCBs were not detected in river sediments and drainage waters of the Swan Canning (NNCP study – see section 2.2.5). This does not indicate that they are not present or having an effect.

2.2.4 Historical information on contaminants in Swan Canning Riverpark

Limited data exists on contaminants in river water, sediment and biota. Work known by the Trust is presented below, with a focus on the dieldrin and DDT. Comparison and interpretation needs to be conservative as data collection and analysis methodology in some cases was not known, or indeed has changed during the past three decades.

Comparison of historic (1974 to 1985) data shows that dieldrin and DDT were present in estuarine water at levels, on occasion more than 30 times above guidelines. Thurlow et al (1986)[6] cited that levels present in the Swan estuary were similar to those reported in the Preston River, which drains into the Leschenault Inlet (Atkins, 1982) and recommended testing of pesticides in the Swan estuarine sediment and biota. There was no measurable accumulation of pesticides in fish flesh and sediment in the Leschenault Inlet (Atkins, 1982).

Comparison and interpretation of results from previous studies is very limited due to differences in sampling methodology, location, timing (WRC, 1999)[7]. In 1970s and 1980s pesticide levels in the Swan Canning river water were generally below guidelines however there were instances of exceedance, usually in winter. Unfortunately a survey in the Swan in 1996 did not have detection limits low enough for comparison to guidelines levels. Data from the 1980s shows some localised areas of DDT contamination near drain outfalls and slipways. Persistent organics in biota showed that levels were well below standards for human consumption.

WRC (1999) concluded that, despite having insufficient data to adequately ascertain whether organics affect the health of the Swan-Canning, it is likely that the greater

[6] Thurlow, B., Chambers, J. and Klemm, K (1986) *Swan-Canning Estuarine System: Environment, Use and Future*, Waterways Commission report

[7] Water and Rivers Commission (1999) Contaminants in the Swan-Canning Rivers and Estuary

majority of sediments have persistent organic levels below guidelines and that toxicity effects on benthic organisms – and the fish – are extremely unlikely.

2.2.5 Recent information on contaminants in Swan Canning Riverpark

In 2006, as part of its three year non-nutrient contaminants program (NNCP), the Swan River Trust initiated a baseline investigation of contaminants in the sediments and drainage water of the Swan Canning river system. This study was intended to provide a baseline for future management and was designed to build an understanding of the long-term environmental impacts of more than 1.5 million people living in the Swan Canning catchment. Overall, the investigations showed that there is a range of contaminants entering the system through the drainage network, including dieldrin.

A comprehensive investigation of 77 catchments sites (drains and tributaries)[8] was undertaken in 2006. This investigation showed some high levels of contaminants throughout the catchment, including levels of organochlorine (OC) pesticides above guidelines levels. In particular the Helena River had the highest number of individual OC pesticides detected and typically the highest concentrations. Other drains, including South Belmont and Bayswater, are known to be contributing organochlorines to the system.

Sediment samples were taken in November 2007 by the Department of Water on behalf of the Trust and a report was released in March 2009[9]. The investigation focussed on 20 river sites that were selected based on the outcomes of an earlier drainage study, historical reports as well as their proximity to disused waste disposal and contaminated sites. Overall the contaminants found in the sediments were typical of an urban catchment and a suite of contaminant levels were comparably better than many urban estuaries elsewhere. However, there were areas of the river where particular contaminants were above sediment guidelines. Areas around the mid reaches and CBD were found to have dieldrin, DDE and some metals above sediment guidelines and were identified as priority sites for further investigation. Two sites in the Canning River were also identified as priority (see section 4.2 for further work)

2.3 Water Quality

There is evidence from elsewhere that rapid changes in water quality and/or toxic algae may play some role in dolphin deaths. An interrogation of the extensive Swan and Canning rivers water quality database was undertaken to consider these factors over the periods of the dolphin deaths. This desk-top study did not identify any phytoplankton that would adversely impact on dolphin health. There were some species that have been previously implicated in fish deaths present in river in June 2009, but these were not at densities that would have been viewed as problematic. It should be noted that sampling focuses only on phytoplankton and does not specifically target harmful species and sampling methods may result in misrepresentations/underestimations of fragile species (some of these fragile species are known toxin producers that could potentially impact upon dolphin health).

[8] Nice et al (2009). A baseline study of contaminants in the Swan and Canning catchment drainage system. Water Science Technical Series Report No. 3. Department of Water Western Australia

[9] Nice et al (2009). A baseline study of contaminants in the sediments of the Swan and Canning estuaries Water Science Technical Series Report No. 6. Department of Water Western Australia

The desktop investigation also looked at physico-chemical conditions over the period of dolphin deaths and there were no consistent patterns in water conditions for the June 2009 and September/October 2009 period. This information is available to the public via the Swan River Trust web site. Between July and August 2009 the Swan River switched from being saline (22 to 28 parts per thousand) to being a more marginal (4 parts per thousand) and remained that way for much of September. In the Canning River, the Kent Street weir boards were removed in late June 2009 and the saline condition of the river downstream rapidly changed to fresh and remained that way through September/October 2009. A halocline of saline water sitting below more fresh water was present throughout this period and resulted (through biological oxygen demand and limited mixing) in some oxygen depletion. This is a natural phenomenon and the location of these oxygen depleted areas varied over the time period. Warm water (17 to 21°C) and fresh - marginal salinities in a wider area of the mid and upper Swan as well as Canning River may have been supportive of unknown pathogens.

2.4 Interagency collaboration

Government agencies and departments with joint responsibilities for aspects of river management as defined by the *Swan and Canning Rivers Management Act 2006,* work closely together on an ongoing basis with well-established protocols in place to do so effectively for the public interest.

Agency	**Role**
Department of Environment and Conservation	lead for mammal (dolphin) injuries, strandings and deaths and pollution response
Swan River Trust	lead agency for issues associated with water quality
Department of Fisheries	fish health
Department of Water	monitoring support and advice on water quality in the river and catchment
Department of Health	human health advice including eating fish etc from the river, swimming in the river
Research institutions	contracted for research projects as appropriate to inform river management

2.5 Communications

The Trust keeps the Minister for Environment, river management project partners, river stakeholders and the public informed of changing river conditions through the issuing of media statements, website information and other regular channels of communications such as the Algae Activity Report (Channel 9 TV Weather Report 6pm Friday, The West Australian Newspaper weather page each Monday). Reports are based on the Trust's weekly water quality monitoring and on-river inspections as part of day to day operations. Information gathered in the weekly monitoring runs on the Swan and Canning are interpreted by the Department of Water's Water Science Branch. If data suggest anomalies or potential public health issues, appropriate management actions are taken in line with formal protocols.

It should be noted that where serious environmental or public health issues may be arising, there is a clear mandate and demonstrated practice of the Trust to alert the relevant parties, with very good support from the media in this endeavour. In managing a complex natural system such as a river and estuary, it is neither

appropriate, nor warranted, to issue alerts for every minor or individual event of deaths of the river's biota. The general community concern concerning dolphin deaths is well appreciated, but as statistics from the Department of Environment and Conservation show, marine mammals die from a range of causes on a continuing basis and it would be inappropriate to announce each individual case where there was no evidence of connections to a wider problem.

2.5.1 Minister

The Minister will be informed of any further dead dolphins in the Swan Canning Riverpark.

2.5.2 Media

A list of media statements provided in 2009 is at Attachment 4.

2.5.3 River stakeholders

The Trust keeps river stakeholders informed by regular email updates and the public via its website when there is new information to share.

Key stakeholder groups include:

- State Government Departments (DEC, DoW, DoH, DoF, Transport, Water Police, Marine Safety)
- Local Government
- Swan River Trust – Technical Advisory Panel
- East Perth Redevelopment Authority
- Fremantle Ports
- Natural Resource Management regional and sub-regional groups
- WWF
- Perth Zoo
- Conservation Council
- Recfishwest
- River Guardian - Dolphin Watch Volunteers
- Environmental Health WA
- Recreational river users (boating, fishing, diving and canoeing clubs)
- Commercial vessel operators

2.5.4 Community input to dolphin research

In April 2009, the Minister launched the new Dolphin Watch Program which now has 65 active members of the public participating. These volunteers are River Guardian members who are provided with free training to assist Dr Hugh Finn with research by monitoring and submitting regular monitoring reports on dolphin location and behaviour in the upper Swan and lower Canning rivers.

3 COMPARISON AND LEARNINGS FROM PREVIOUS DOLPHINS DEATHS

3.1 United States

Previous mass mortality events in dolphins have occurred in: the United States waters a number of bottlenose dolphin mortality events, including the death of more than half of the inshore population along the east coast during 1987-88; four events in the Gulf of Mexico (1990 to 1994) (each involving the death of more than 200 animals); and 107 animals in the Florida Panhandle event in 2004. Studies have

shown that some marine mammal species, including bottlenose dolphins in US waters, have decreased immune system function as a result of exposure to such chemicals as PCBs and DDT, and algal toxins may have been involved in the US east coast dolphin mortality of 1987-88 as well as in recent events in the Gulf of California. (information provided by Australian Wildlife Network).

Morbillivirus has been implicated in the deaths of dolphins in the US and there have also been morbillivirus outbreaks in Europe. Testing for morbillivirus requires viral RNA assessment using a strict protocol and it may not be possible to retrofit testing to the Swan River dolphins. However, any future post-mortem work on dolphins and other marine mammals needs to be considerate of the strict requirements of sample preservation so that these tests might be conducted (pers comm. P. Duignan, University of Melbourne).

3.2 Gippsland Lake, Victoria[10]

There have been 15 dolphin deaths in Gippsland Lakes, Victoria since 2006, out of a population of approximately 50 dolphins. The skin lesions on the tail stock of the Swan River dolphins appear to be similar to that seen in the Gippsland Lakes dolphins where sampling indicated that it was dolphin pox virus with secondary fungal and bacterial infections. These dolphin pox lesions start black and circular, then progress into a more fungal looking lesion, then recover to be white tattooing. In the Gippsland Lakes they have seen the persistence of these lesions for more than two years.

The Gippsland Lakes underwent a massive flooding and changed from a largely salt-water system with average temperature of 10°C to a freshwater system with average water temperature of 20°C. The change in environmental conditions also resulted in algal blooms. There are, therefore, a number of factors that may or may not have contributed to the dolphin deaths. Over the same period, there were eels and fish recorded with skin lesions and several incidences of fish kills.

The Gippsland Lakes dolphins had extremely high levels of mercury - levels known to be detrimental to the health and are likely a contributor to death of the Gippsland dolphins. There is a suggestion that dolphin pox appears to be an outward sign of an immune-suppressed animal and any environmental changes may exacerbate any 'issues'.

Researchers in Gippsland Lakes have investigated the problem but are only a little closer towards knowing the causes and what to do. They suggest this raises questions about catchment management and minimising environmental change (where possible). Gippsland researchers hypothesise that rapid environmental change appears to 'tip' already immune-suppressed animals 'over-the-edge'. For small populations this is a major concern.

3.3 Cockburn Sound

A 2009 study estimated that 27% of 158 bottlenose dolphins in Cockburn Sound have been observed with skin lesions. Prevalent in all age classes, with calves having most prevalent. Differences between sex prevalence unknown (Ham 2009[11]).

[10] based on discussion with J. Weir, Dolphin Research Institute, Victoria and K Charlton-Robb, Monash University

[11] Ham, G.S (2009). Population biology of bottlenose dolphins (*Tursiops* sp.) In Cockburn sound

3.4 Elsewhere in the world

- In the Mediterranean Sea, 6,000 striped dolphins (*Stenella coeruleoalba*) died from 1990 to 1992. A number of causative factors have been considered including Morbilliviruses, chemical contaminants.
- NE Scotland: high prevalence skin lesions in bottlenose dolphins (90 to 100% population).
- Santamonica Bay and waters off California: 79% bottlenose dolphins population affected.
- Sado estuary, Portugal: 15 to 29% bottlenose dolphins population affected.
- Paranagua estuary, Brazil: 17% Guiana dolphins affected.
- Mayotte lagoon (between Mozambique and Madagascar): 8% Indo-pacific bottlenose dolphins affected.

3.5 Swan River

Table 2: Pre 2009 Dolphin Death Records – Swan Canning Riverpark

Date	Sex /age	Location recovered	General notes	ICMS
*18 Nov 2007	Female	Bicton, Beach St	Info provided by H. Finn. No record in Trust system, necropsy at Perth Zoo, necropsy report provided, refers to recovery by DEC diagnosis: likely "dolphin pox"	NA
*5 Nov 2007		Point Walter spit	Trust took measurements and sent info to DEC, City of Melville removed carcass, no photos available, DEC database notes "advanced decomposition, cause of death unknown"	10247
22 Dec 2006		Blackwall Reach	Reported by Water Police, collected and disposed of by the Trust, unclear whether reported to DEC	8022
21 Oct 2006			Complaint about dead dolphin stored at Trust depot, no other info available	7637
*7 Oct 2006		Freshwater Bay	Removed by Trust, photo available, very decomposed, disposed of by Trust, reported to DEC, database notes "advanced decomposition, cause of death unknown"	7524
27 Oct 2003			Photo only from operational records, Ascot, appears to have skin lesions	NA
21 Mar 2002			Photo only from operational records, dolphin calf and mother in water	NA

*****Entries recorded in DEC database

3.6 Statewide / Bunbury

Table 3: Dolphin death and stranding records from WA coast other than Swan Canning Riverpark from 1 January 2006 to 17 November 2009

Year	DEC database		Additional from Murdoch records – Bunbury-Peel region (not in DEC database)
	Deaths	Stranding	Deaths
2009	28*	5	5
2008	3	2	4
2007	8	2	1
2006	13	1	2

* of the 28 in 2009, 24 are from the south-west (Perth to Augusta). The other four are from Jurien Bay, Carnarvon, Point Hedland, and Karratha.

Information on dolphin research in the Bunbury area is provided in Attachment 3.

4 CURRENT WORK

4.1 Routine monitoring

Together with the Department of Water, the Trust routinely monitors the river for phytoplankton and a range of physical and chemical variables – nutrients, salinity, temperature, dissolved oxygen, pH etc. These are reported to the public. Phytoplankton samples are taken at nine locations in the Swan River and seven in the Canning River. Physical and chemical variables are sampled at seven locations in the Canning and 20 locations in the Swan. This sampling is complemented by fortnightly sampling of 15 catchment sites.

4.2 Extension of the 2006 Non-nutrient Contaminant Program

Since the Swan River Trust released the findings of the 2006 non-nutrient contaminants program, the Trust and Department of Water has initiated further studies to look at the potential toxicity of the sediment to a range of fauna, including fish, crustaceans and mussels. These investigations are still under way and are centred on one site in East Perth and one site in Bullcreek.

Bioaccumulation of organic contaminants at the East Perth site is also being investigated. The East Perth and Bullcreek locations were selected based on the number and type of contaminants of potential concern.

4.3 Other research on environmental contaminants and indicators of ecosystem health

The Swan River Trust Swan Canning Research and Innovation Program aims to improve the scientific knowledge underpinning management of the Swan Canning river system. It supports collaborative research between the Trust and education and research organisations to develop innovative solutions to challenges in the river system.

There is a range of studies under this program that are focused on contaminants and indicators of environmental health. Findings from these investigations were recently highlighted at a science showcase (August 2009) where findings from a broad selection of the studies were presented to a wide range of stakeholders.

Research	**Institution**
Endocrine disruption in urban drains	Curtin University
Status of Fish Health in Claisebrook Cove	Curtin University
Implications of exposure by agriculture and urban runoff to crustaceans within Swan-Canning catchments	Curtin University
The chiton fauna of the Swan River Estuary and their potential role as indicators of environmental contamination	University of Western Australia
Toxicant exposure, population genetics, and trophic associations of bottlenose dolphins (*Tursiops* sp.) in the	Murdoch University

Swan River	
Synergistic impact of drift algae, invasive species and environmental stressors on seagrass health and ecological interactions	Edith Cowan University
Application of high-resolution laser optical plankton counting technology for the study of spatial and temporal distribution of zooplankton in the Swan-Canning System	University of Western Australia
Development of fish larvae and zooplankton as indicators of ecosystem health in the Swan-Canning Estuary	Department of Fisheries
Development and validation of an estuarine health index using fish community characteristics	Murdoch University
The biology of the Black Bream, *Acanthopagrus butcheri*, in the Swan-Canning Estuary has undergone short-term, marked changes: implications for stock assessment	Murdoch University

4.4 Dolphin collection procedures

Letters to riverside councils on 2 November 2009 reminding them of importance of notifying DEC regarding any sick, injured or dead dolphins.

The Trust has developed detailed procedures on the collection and reporting of any deceased dolphin found in the Swan Canning Riverpark. Trust operational staff are to liaise with DEC Nature Protection Branch and Murdoch University in ensure that dolphins that are not in an advanced state of decomposition are transferred to Murdoch Vet school for necropsy. If dolphins are in an advanced state of decomposition Trust staff collect relevant measurements and tissue samples for analysis. This information is forwarded to DEC Nature Protection Branch with copies maintained at the Trust.

4.5 Dolphin behaviour tracking

Recruitment of further Dolphin Watch volunteers from those members of the public who wish to help protect the dolphins would be of benefit to the science. The Perth community would also benefit from a public education program regarding the protection of dolphins focusing on reducing: fishing line entanglement; river boat speeding; drains disposal for households chemicals (paints and oils) and general rubbish disposal. The Trust has been communicating these community river-care messages for many years to the extent that resources allow. An expanded ability to facilitate a refreshed program in the light of the recent dolphin deaths would benefit the future protection of all the fauna and flora in the rivers, as well as the water quality and foreshore conditions in general.

Australian and international experience has shown that environmental management programs are most effective when the community understands the issues and plays a part in the solutions. Community engagement and education programs are in place across government agencies and need to be adequately funded to reach a wider community and be effective for the long term.

4.6 Contaminant sources

4.6.1 Contaminated sites

While its highly probable that the sources of some of the contaminants of concern in the dolphins, such as dieldrin and DDE, are historic sources of contamination, the Swan River Trust has requested from DEC a fast-tracked desktop search of

contaminated sites to determine if there are any obvious sources of dieldrin, DDE and PCBs in the catchment with a focus on sites identified through the Trust Non-nutrient Contaminant Program.

4.6.2 Industrial audits

Perth Region NRM has worked with local government in addressing potential contaminant sources from light industry. It has audited more than 5,000 small to medium enterprises and found 35% illegally discharging. Through this work PRNRM has been able to reduce the figure to 2% and expects to reach 0% in the project area by the end of the year. To date the majority of this work has focused on light industry outside the Swan Canning catchment (eg Cockburn, Rockingham, Stirling, Wangara, Kwinana and regional centres). Funding is no longer available to extend the program into other areas, however given the threat of ongoing or new sources of contaminants to the Swan Riverpark there is value in expanding the program into industrial areas of the Swan Canning catchment such as Canningvale and Welshpool.

4.7 Fremantle Ports

Fremantle Ports runs a Marine Quality Monitoring Program (MQMP) which includes annual sampling of sediment, water and mussel tissue at seven sites in the Inner Harbour, two in Rous Head and an upstream site at Blackwall Reach. Parameters analysed include heavy metals, tributyltin (TBT), polycyclic aromatic hydrocarbons (PAHs), nutrients, chlorophyll *a*, total suspended solids, alkalinity, salinity, temperature, dissolved oxygen, pH and light attenuation.

Fremantle Ports also currently monitors three sites in the Inner Harbour (one in Rous Head) on a fortnightly basis and collects upstream data from Blackwall Reach site via the Trust's weekly environmental monitoring program. Parameters collected on these sampling occasions include nutrients, chlorophyll *a*, total suspended solids (TSS), alkalinity, salinity, temperature, dissolved oxygen and pH.

In preparation for the Inner Harbour dredging operations Fremantle Ports was required to gather (and report) baseline sediment and water quality data, including heavy metals, TBT, PAHs and organochlorines.

Under Ministerial conditions of approval for the Inner Harbour dredging operations (expected to start early January 2010) Fremantle Ports is committed to comply with strict environmental conditions, including immediate management response if environmental trigger values are exceeded. These trigger values are below levels at which environmental harm would occur.

Fremantle Ports will continue its monitoring at the above 10 sites in the proximity of the port, including Blackwell Reach. This monitoring will occur during and after the dredging operation.

The Fremantle Ports hydrodynamic modelling (as well as experience from the 1989 harbour deepening) indicates that the dredging is unlikely to affect the river upstream of the Fremantle Traffic Bridge. Fremantle Ports is committed to expanding its monitoring program upstream of the Fremantle Traffic Bridge to include monitoring of TSS and light attenuation and whether there are contaminants (PAHs, organochlorine pesticides, metals and TBT) in sediment and mussels at a location to be determined in negotiation with the Trust. Fremantle Ports will also monitor potential sediment plumes by doing aerial sweeps along the coast and up the Swan

River. The results of all monitoring will be publically accessible via the Fremantle Ports website.

5 CURRENT MANAGEMENT ACTIONS

The Trust has a number of existing management programs in place aiming to improve the ecological health of the Swan Canning river system.

Building on the Swan-Canning Cleanup Program, the Healthy Rivers program was developed by the Trust to protect the environmental health and community benefit of the Swan and Canning rivers by improving water quality. Eight programs provide a 'catchment to coast' integrated approach for river management:

- Coordination
- Healthy Catchments
- Landuse Planning
- Drainage Nutrient Intervention
- River*bank*
- River Health
- Community and Partners
- River Science

The soon to be released Swan Canning Water Quality Improvement Plan complements the Healthy Rivers Action Plan focusing on management actions in the catchment to reduce nutrient load to the rivers by 50%.

The Trust Boating Management Strategy (BMS) was developed to ensure sustainable boating practices in the river by addressing the following range of boating issues and activities which may affect the enjoyment and health of our waterways:

- boat accommodation including moorings and marinas;
- dinghy storage on foreshores;
- boat maintenance practices;
- boat wash;
- boat noise;
- fuel and oil discharge;
- boat launching facilities;
- sewage disposal;
- jetties; and
- anchor and boat damage to the riverbed.

The BMS makes a number of recommendations on boating issues although none directly related to wildlife. Recommendations indirectly related include reducing contaminants entering the waterways through implementation of Best Management Practices and auditing of current practices of slipway facilities adjacent to the river. Establishment of low wash zones or speed restrictions in areas with significant environmental public safety or property risks. (It should be noted there are no recorded deaths as a result of boat strike in the Swan Canning Riverpark). The Trust also works directly with yacht club and marina managers to improve environmental management of their sites, with a strong focus on slipway discharge management.

6 UNANSWERED QUESTIONS

There is a range of issues that need to be addressed to fully understand what is happening to the dolphins and how these relate to contaminants in the environment. There is recognition that this issue may not be isolated to the Swan and Canning rivers and that the recent deaths of dolphins in the Leschenault Inlet and wider south-west raise broader question about causative effects.

Broadly, there is a need to understand the effect of disease, contaminants, entanglement, and other threatening processes and develop management strategies that mitigate human activities causing injury and mortality. If this problem is shown to be wider than the Swan and Canning rivers then research needs to take in a wide geographic spread (eg south west WA) and include a range of species to effectively evaluate processes that are complex (eg disease, bioaccumulation of contaminants).

Specifically we don't know:

- whether the contaminant levels observed in the Swan River dolphins is contributing to the death of the dolphins;
- whether an infectious disease such as a morbillivirus is involved;
- definitively whether the six dead dolphins were part of the 20 to 25 resident community in the Swan Canning;
- what the natural incidence of skin lesions is in the Swan River dolphins;
- what role is played by (the generally low level of) contaminants in fish;
- whether contaminants are affecting other species;
- background levels of contaminants in the environment beyond the Swan Canning Riverpark (eg Western Australian coastline); and
- whether this issue is bigger than just the Swan River dolphins, as emerging at Bunbury may demonstrate.

7 FURTHER ACTIONS

7.1 Science communications

Keeping the community informed with up to date information is a key component of a way forward in Perth, where the river is an emotive icon and all activity on it is so highly visual and central to Perth's lifestyle. Public education and involvement programs need to be maintained and enhanced so that those in the community wishing to be involved can do so in a meaningful way. They can help in informing the science of Swan River dolphin behaviour patterns and preferred locations and through education people can learn how to change their behaviours to protect river wildlife, water quality and foreshore condition. Up to date science communications materials need to be developed in line with other places in the world. Distribution needs to be considered locally first, but also nationally and internationally, sharing knowledge and contributing to visitor and tourism attraction to the Swan Canning Riverpark.

7.2 Proposed further research

The Trust will continue to work with the research institutions and relevant Government agencies to take further stock of the large amount of information that has come forward in recent weeks. A rational and careful assessment must be made to ensure any future research and monitoring effort is best targeted, will provide a

sound basis for management and delivers value for money to the State of Western Australia. Naturally, the proper procurement and contracting processes must be followed in the public interest.

It is particularly important that if sufficient grounds are made to establish commonalities between dolphin deaths in the Swan Canning and other waterways such as the Leschenault-Bunbury waters, this will have a major bearing on next steps. As noted above, contaminant analysis from Leschenault Inlet dolphins is yet to be completed. The following research and monitoring actions may be appropriate as an immediate response:

- establish advisory panel – steer research into the dolphin deaths and contaminant assessment;

- contaminant survey in key biota – immediate investigation of contaminant levels in key fish and crab species for human consumption and environmental health in the Swan Canning Riverpark - to include organochlorines, PCBs and other contaminants;

- contaminant source management – industry audits of 4,000 premises in the in Swan Canning catchment and followup education/management actions to reduce new contaminant sources;

- science communications – communication and education program to focus on fishing line entanglement, River Guardians recruitment and community progress reporting; and

- continuation of post-mortem pathology and contaminant assessment – one year project to improve understanding of a range of factors affecting dolphins widely (not limited to Swan River dolphins).

Depending on the outcome of these actions, a further series of consequential studies could improve our understanding of what is happening with the dolphins and contaminants in the Swan River and more widely in the south-west but should not be committed to at this stage:

- marine mammal health – 4 year investigation to determine incidence of disease and factors contributing to the mortality in marine mammal and develop surveillance programs;

- ecotoxicology – 4 year investigation to examine bioavailability, bioaccumulation and toxicology of organic contaminants in dolphins and wider species in the Swan Canning;

- population assessment – 4 year investigation to assess the size, composition and conservation biology of the Swan River dolphin community;

- contaminant investigation –
    - evaluate potential sources of contamination in the drainage system
    - assess concentration of contaminants in the water of the Swan and Canning rivers as snapshot for comparison to historic levels
    - undertake further ecotoxicological work to understand the risk of contaminants to a range of fauna and possible bioaccumulation pathways; and

- recruitment of more public volunteers to River Guardians Dolphin Watch – develop community resources, organise more training to assist the existing science research program and provide volunteer management ability.

ATTACHMENTS 1 - 3

Provided by Murdoch University

1 Summary of the 2009 Swan River Dolphin Necropsies

2 Notes – Resident Status of Dolphins in the Swan-Canning Estuary

3 Overview of Dolphin Research and Mortalities in the Bunbury area 2007-09

ATTACHMENT 4

List of media statements from the Trust (or Minister for Environment) on river health in 2009

23 January – Trust monitoring high levels of *heterosigma akashiwo* in the lower Canning River

6 February – Trust monitoring elevated levels of *Anabaena circinalis* (blue green alga) in the Canning River

18 February – Statement from the Minister – release of draft report and scientific modelling for the *Swan Canning Water Quality Improvement Plan* to help understand catchment condition to improve river health

17 March – announcement by Minister of seven new research projects funded by the Trust, Murdoch University's project *Toxicant exposure, population genetics, and trophic associations of bottlenose dolphins (Tursiops sp.) in the Swan River*

30 March – release of findings from three-year Non-nutrient Contaminant Study

22 April – Trust monitoring harmless alga bloom (*Euglena*) in Canning River

15 May – Trust monitoring elevated levels of *Karlodinium veneficum* in Canning River

3 June – Trust advises reduction in *Karlodinium veneficum* but persistent low dissolved oxygen in this stretch of the river could still pose a risk and for the public to report dead or sluggish fish

5 June – Trust warns public to keep away from a female bottlenose dolphin displaying protective behaviours toward her dead calf in the Swan River in the Fremantle area

9 June – Two dead dolphins removed from Swan River

19 August – announcement of Swan Canning Research and Innovation Program Showcase where WA scientists presented their current river projects

20 August – Trust hosts 53 international delegates of the Society for Ecological Restoration International conference on a river restoration field trip

3 September – Trust responds to a diesel spill in the Swan River between the Nedlands jetty and Nedlands Yacht Club

14 September – Minister announcement of State Government monitoring dolphins