

## Collie Pit Lakes- Potential Health Risks

Andrea Hinwood, Helen Tanner, Jane Heyworth and Clint McCullough




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## Pit Lakes

- Form in open cut mining pits which extend below the groundwater table
- Worldwide phenomenon e.g., Canadian Oil Sands Lakes
- Often differ from natural lakes
  - Smaller catchment, but greater depth
  - Less nutrients
  - Low pH
  - Higher metal concentrations
  - Physical characteristics, high walls etc
- Potentially valuable community resource



## Pit Lakes in Collie

- In Collie 15 Pit Lakes;
- 3 commonly used for recreational activities



## Collie Lake District




## Study Aims

- To assess the potential for health impacts from recreational use of the Collie Pit Lakes.
- This study was part of a broader research program to understand pit lake resources within the Collie Basin

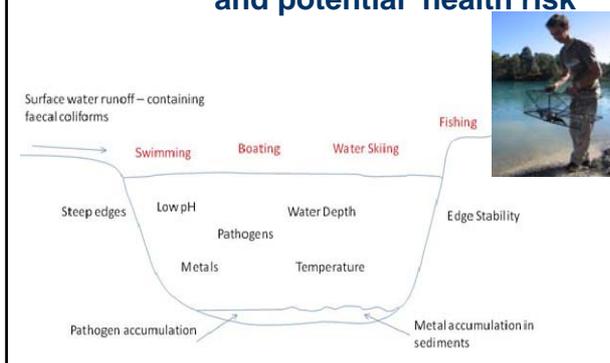
## Methods

- Literature review
- Community survey on current use of 3 main pit lakes
  - Black Diamond Lake
  - Lake Stockton
  - Lake Kewari
- Screening risk assessment (using water quality data from MiWER database)

## Literature Review Results

- No studies on health impacts of recreational use of pit lakes
- Studies on water quality suggestive of potential for health impacts
  - Low pH
  - Some elevated metals concentrations (arsenic, lead, tin and mercury not measured)
  - Physical injury
  - Vector Borne Disease

## Characteristics affecting exposure and potential health risk



## Target Pit Lakes

- This study assessed the 3 most commonly publically used pit lakes in Collie;
  - Black Diamond,
  - Kewari and
  - Stockton.
- Assessed health risks associated with human contact specifically through recreational activities.



## Community Survey

- Random survey of residents of Collie Shire
- Plus special interest groups
- Questionnaire covered:
  - Uses;
  - Frequency of use;
  - Duration of use;
  - Health symptoms.

## Results

1,265 Questionnaires Distributed

250 responses:

- 176 (15%) Random survey
- 74 (43%) Targeted survey
- 57% respondents male
- Overall 62% used the lakes
  - RS 58% ; TS 69%
  - 2.8 persons/households



## Recreational activities undertaken by pit lake users, Collie Pit lakes.

	Black Diamond (n=127) %	Stockton Lake (n=123) %
Swimming	83.5	72.4
Picnicking	42.5	47.2
Wading	31.5	24.4
Camping	20.5	30.9
Kayaking/Canoeing	15.0	15.4
Marroning	11.0	12.2
Walking	7.9	2.4
Boating	6.3	40.7
Water skiing	2.4	27.6
Fishing	1.6	1.6

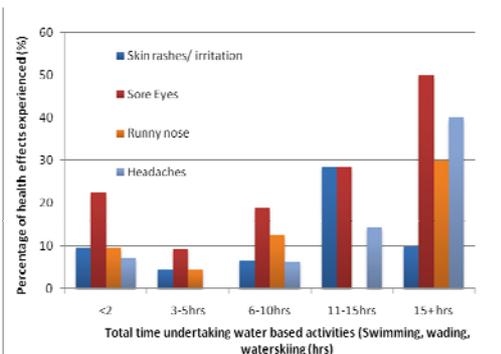
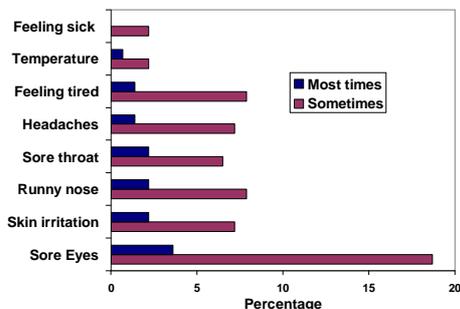
## Uses



## Frequency of use

- (n=154)
- Median days/month= 2
- days/year=10
- November to March
- The average time spent on water-based activities - 3 to 5.5 hours.
- 33 (22%) go marroning
- 42 (27%) eat seafood caught from lakes

## Health Symptoms



Percentage of health symptoms by the time spent undertaking water based activities.

## Concerns of Q. Respondents

- **Lack of facilities**
  - Toilets
  - Rubbish collection
  - Shade
  - Access
  - Picnic tables/ BBQs
- **For non-users (91)**
  - Not interested in these activities or used other sites (61%)
  - Safety (22%)
  - Health impacts (19%)



## 2009 Water Quality (µg/L)

Parameter	Black Diamond	Kepwari	Stockton	ADWG* RWG**
pH (median)	5.5	4.5	5.4	5-9**
Arsenic	37.5 <DL# -50 n=2	<DL# n=2	44.5 (25-64) n=2	7* 50**
Cadmium	<DL# n=2	<DL# n=2	3.4 0.1-5.0 n=3	2* 5**
Mercury	170.6 100,241 n=2	<DL n=2	27.5 5.50 n=2	1* 1**
Aluminium	<DL n=2	3,580 1,650; 5,510	452 23-1,350 n=5	7* 50**
Manganese	134 51,200 n=2	250 250-616 n=6	86.3 5-140 n=4	300**

\*Australian Drinking Water Guidelines.  
 \*\*Recreational Water Quality (ANZECC/ARMCANZ 2000).  
 \* Surface water values except for turbidity which is a measure of depth.  
 # Detection Limit above guideline values.



## Water Quality – pH/Metals

- pH low
- Few samples
- Inappropriate detection limits i.e., higher than ADWG or RWQ guidelines
- Analytical techniques may not have been appropriate
- Mercury, arsenic and aluminium all high?



## Qualitative Assessment - biological quality

- Environment could support pathogenic bacteria, viruses and midges, mosquitoes
- Biting midges present in sampling – no reports from Questionnaire this is an issue
- No other species identified of concern
- Potential exists for *E. coli* from human and animal waste

Biological Contaminant	Likelihood of occurrence	Potential Health Risk (based on likelihood of occurrence)
<i>E. coli</i>	Possible - dependent on potential sources	Unknown
Cyanobacteria	Presence not identified. Blooms unlikely to occur due to lack of nutrient input	Low
<i>Cryptosporidium parvum</i> oocysts	Possible - dependent on potential sources	Low-medium
<i>Giardia lamblia</i> cysts	Possible – dependent on potential sources	Low-medium

### Preliminary Health Risk Assessment

- Mercury as an example- exposure based on 1 day
- Swim for 3.5 h
  - consume 100 mL water
- Consuming seafood (worst case)
- National Nutrition Survey:
  - general population mean intake of 115 g/day

### Exposure assessment

➤ Exposure level =  $\mu\text{g}/\text{kg}/\text{day}$

(Ingestion rate x concentration contaminant x duration of exposure)

+

(Ingestion rate of seafood x level of contaminant)

/(body weight/day)

### RA continued

- Exposure level = 68  $\mu\text{g}$  per day/64kg/day
- = 1.06  $\mu\text{g}/\text{kg}/\text{day}$
- Average case= 1.06  $\mu\text{g}/\text{kg}/\text{day}$
- Worst case = 3.07  $\mu\text{g}/\text{kg}/\text{day}$  (child higher)
- Tolerable Daily Intake = 2 $\mu\text{g}/\text{kg}/\text{day}$  (WHO 2005)

### Risk characterisation

- Organic Hg more toxic
- Form of Hg at Collie pit lakes not known
- Provisional Tolerable Weekly Intake for methyl mercury is 1.6  $\mu\text{g}/\text{kg}$  (WHO, 2005)
- Limited data to base assessment on
- Recent testing showed little Hg in water (ICP-MS)

### Risks of Recreational Use of Pit lakes

- Based on mercury, arsenic, aluminium and manganese concentrations and exposure scenarios - risks likely to be low
- Low pH is an issue
- Data quality - poor

### Limitations

- Lower than desired questionnaire response rate
- Good preliminary information on recreational use
- Need better WQ data to better characterise risk
- Need WQ data with detection limits below relevant guidelines

### Conclusions

- Need good monitoring data to confirm findings of screening risk assessment
- Human exposure study would provide estimate of whether use = exposure and therefore the risk of health effects
- Other exposure sources need to be determined

### Conclusions cont-

- 98% of the 250 respondents to Questionnaire would like to see recreational use of pit lakes
- Management of areas is a priority for the community
- Active management would reduce some of the potential risks

