Toxicants

Ecological risks in Western Port and surrounding catchments

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Enhancing Life and Liveability

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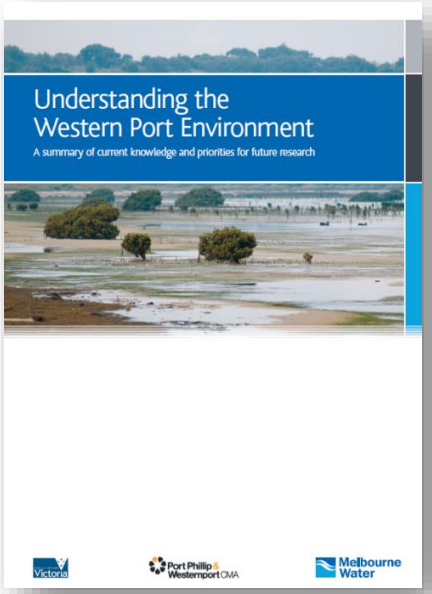
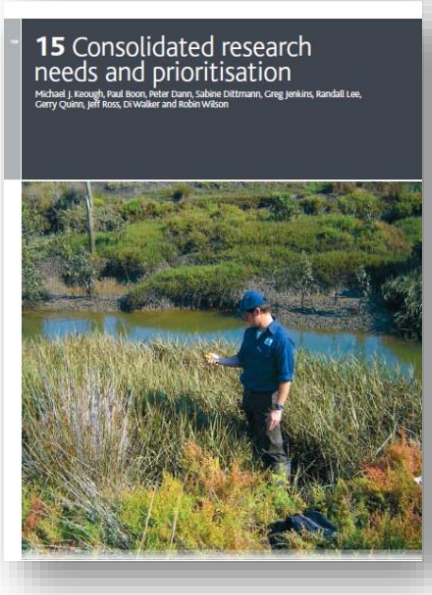
Research Priorities

Research completed to date addresses several priorities identified in the Western Port review (Keough et al. 2011) under the *Toxicant* theme:

- RP 36: Initial estimate of risk from toxicants
- RP 37: Impacts of toxicants on vegetation
- RP38: Investigate toxicant effects (and climate change) on fish





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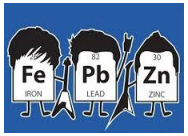
What are toxicants?

"Chemical pollutant that can have toxic effects on biota"[1]


Antifoulants


Pesticides

Hydrocarbons



Heavy metals

Nutrients

Toxicants


Industrial


Agriculture


Cars


Boating


Urban


Roads

Toxicant sources


Seagrasses


Open water


Mud Flats


Mangroves


Salt marsh

Environments at Risk

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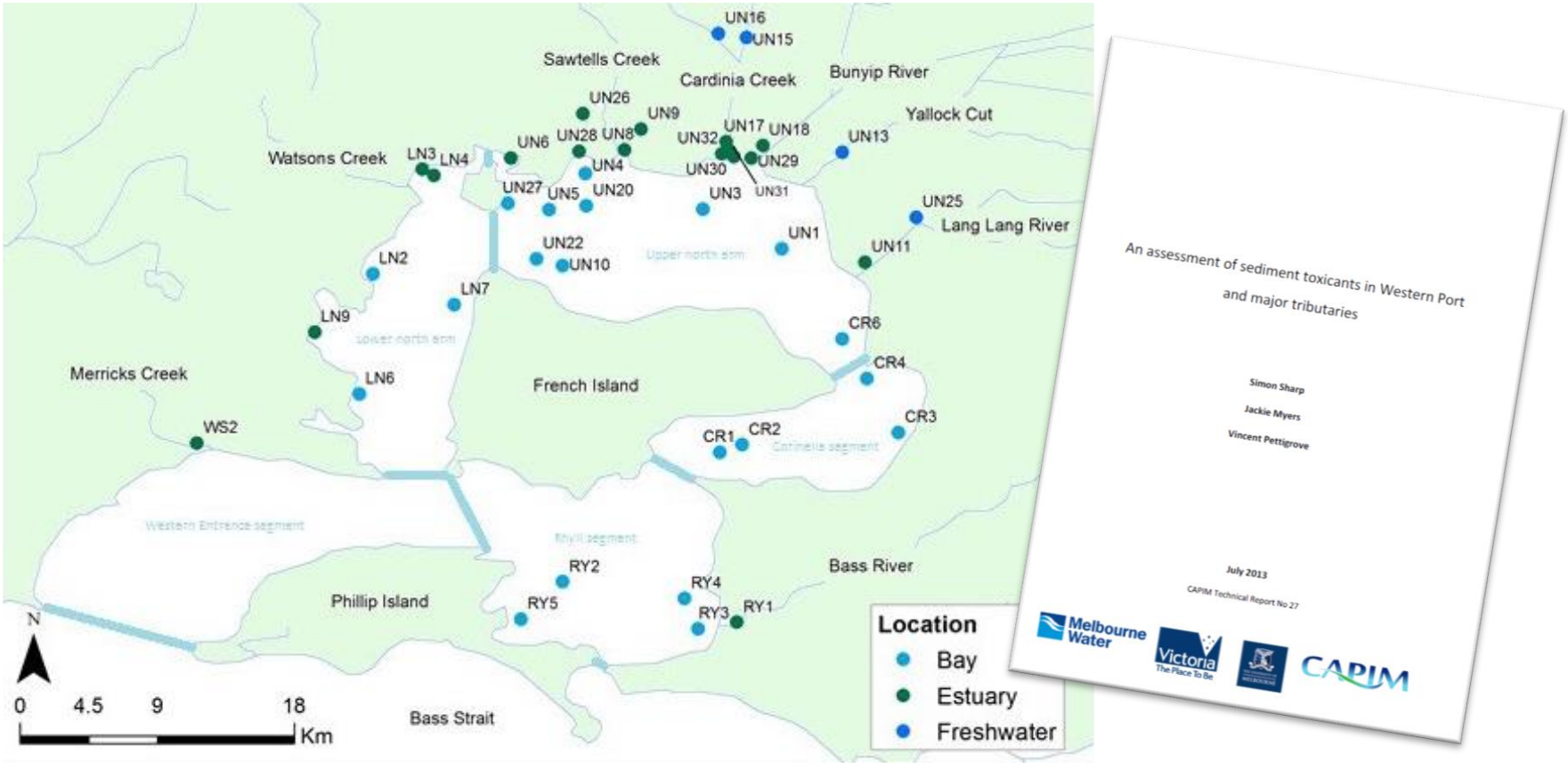
1- ANZECC & ARMCANZ (2000) Australian and New Zealand guidelines for fresh and marine water quality.

Initial estimate of sediment toxicants



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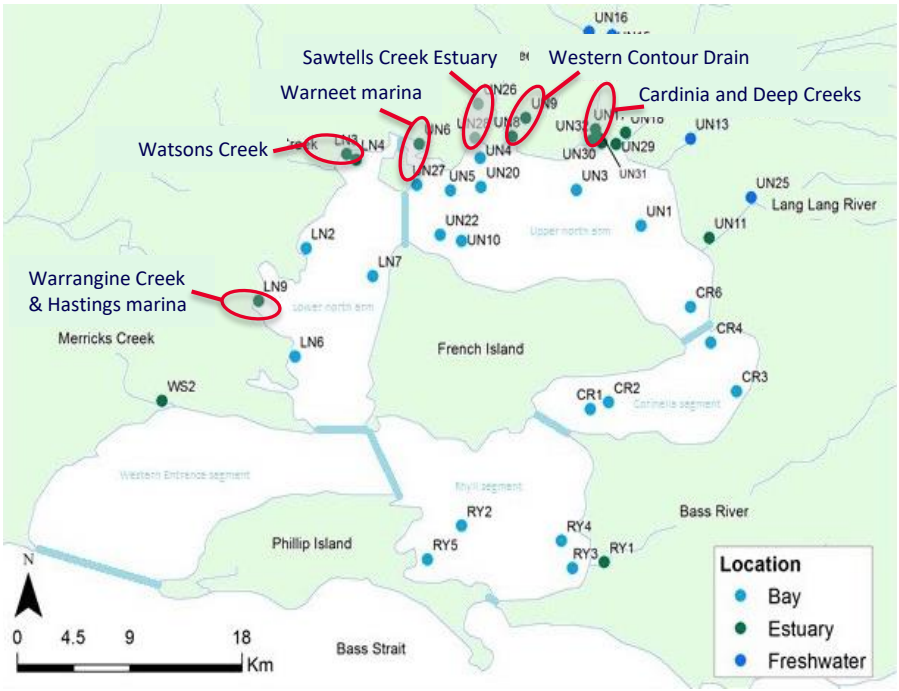
Report available on Melbourne Water Website

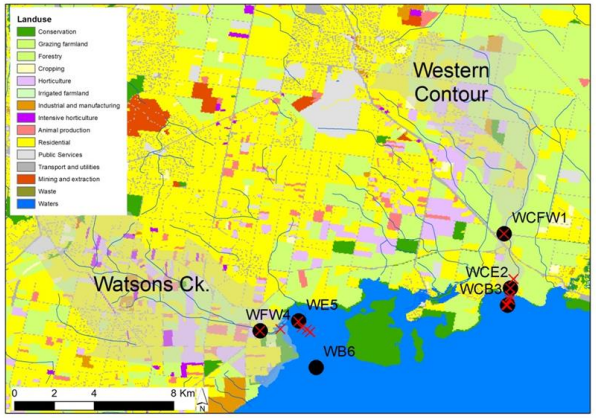
Identified toxicant “hotspots”

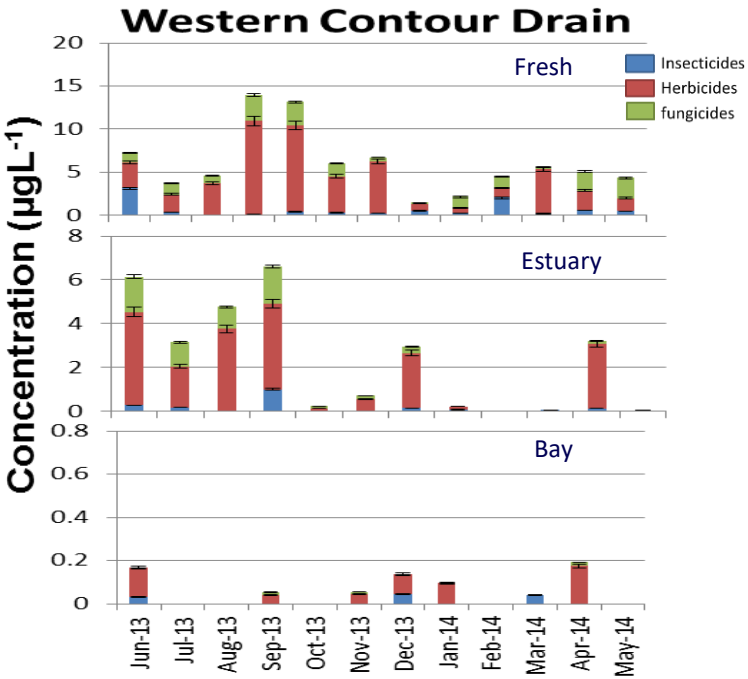


Waterway or Area	Toxicants of concern	
	Pesticides	Metals & Total Petroleum Hydrocarbons
Western Contour Drain	Simazine, prometryn, linuron, metolachlor, boscalid, oxadixyl, azoxystrobin, cyprodinil	
Watsons Creek estuary	Prometryn, linuron, metolachlor, boscalid, pp-DDE, pp-DDT, pirimicarb, fenamiphos	
Sawtells Creek estuary	Simazine, diuron, pp-DDE, bifenthrin	Total Petroleum Hydrocarbons
Deep Creek estuary	pp-DDE, pp-DDT, pirimicarb, simazine, triadimenol	Aluminium
Cardinia Creek estuary		Mercury, cobalt, nickel, zinc and copper
Warrangine Creek		Mercury, cobalt, arsenic, copper, lead, nickel, zinc
Heavy Boat use sites (Hastings and Warneet)		Tributyltin, dibutyltin

Monitoring & evaluating risks to key habitats

- Frequent and widespread occurrence of pesticides
- 43 pesticides detected
- Storm events increase the risk of pesticide exposure
- Fungicides the highest number of different compounds
- Herbicides the highest detection frequency and concentrations





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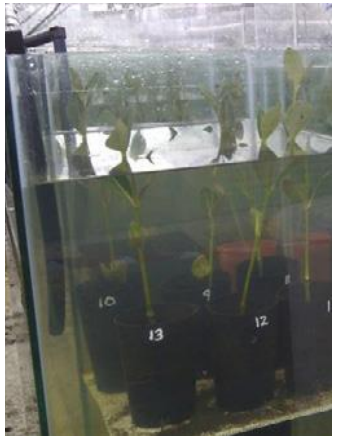
Herbicide risks to marine plants



- Pesticides pose a low-moderate risk to flora communities
- Seagrasses particularly sensitive at ≤ environmental concentrations and < TVs
- Mangroves orders of magnitude less sensitive than seagrasses
- Mangrove seedlings most sensitive life stage
- Environmental concentrations pose a risk to early plant establishment
- Risk greatest to aquatic plants in the upper estuarine and freshwater areas of the catchments

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Pesticide Sourcing and biological impacts

- Pesticides primarily associated with intensive agricultural activities, particularly market gardens
- Detected more frequently and at highest concentrations in mid - lower reaches of catchments
- Wet weather events are associated with increased frequency and elevated concentrations

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Pesticide Sourcing and biological impacts

- Impacts to invertebrate survival, microalgae growth and functional stream health was greatest in mid to lower reaches of catchments
- Correlated with elevated levels of nutrients, pesticides and poor water quality.

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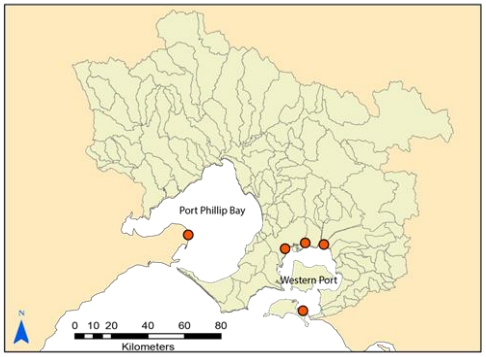
Fish health assessment 2013-2016

- Fish from all sites displayed changes in condition indicating environmental stress
- No strong and consistent results indicating pollution effects
- No signs of endocrine disruption
- Biological measures indicated differences in energy allocations
- Potential concern was occurrence of pre-cancerous and cancerous lesions in livers
- Lack of site specific impacts



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Summary of pesticide data 2012-2016

- A total of 64 different pesticides have been detected
  - 55 in surface waters
  - 20 in sediments
- Commonly occur in complex mixtures – 2 to 22 different pesticides
- 9 pesticides have exceeded TVs, however majority have **NO** TV
- Concentrations occur at levels that could pose risk to flora and fauna

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Summary of surface water pesticides 2012-2016

Pesticide	Group	Detects waters (%)	Maximum Concentration Detected (µg/L)			Trigger Values (µg/L)			Maximum concentration in Passive samplers (µg/disk)
			Fresh	Estuarine	Marine	Fresh[1] 95%	Marine[1] 95%	Marine[2] 95%	
Simazine	H	64	0.71	0.33	0.1	3.2	3.2*	0.2*	4.7
Prometryn	H	64	7.6	2.6	0.12	-	-	-	23
Metolachlor	H	64	**3.1**	**2**	**0.19**	0.02*	0.02*	-	11
Diuron	H	54	**1.1**	0.38	0.08	0.2*	1.6*	1.6	1.6
Iprodione	F	51	2.6	0.17	-	-	-	-	6.9
Metalaxyl	F	49	0.78	0.41	0.03	-	-	-	3.1
Boscalid	F	44	3.3	0.74	0.02	-	-	-	15
Linuron	H	41	1.5	0.88	-			-	0.66
Fenamiphos	I	39	2	0.85	0.08	-	-	-	1.3
Atrazine	H	36	4.8	0.02	0.02	13	13*	1.4	3.8
Dimethoate	I	15	**2.8**	**0.17**	-	0.15	0.15*	-	0.39
Diazinon	I	14	**0.05**	**0.03**	-	0.01	0.01*	-	4.6
Chlorpyrifos	I	5	**0.06**	**0.06**	**0.05**	0.01	0.009	-	0.34
p,p-DDE	I	3	**0.1**	**0.01**	**0.01**	0.03*	0.0005*	-	-
Dieldrin	I	1	**0.06**	-	-	0.01*	0.01*	-	0.04

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Summary of sediment pesticides 2012-2016

Pesticide	Group	Detects (%)	Maximum concentration detected (µg/kg)	Trigger Values	
				ISQG-low	ISQG-high
2,4-D	H	58	48	-	-
azoxystrobin	F	37	1	-	-
boscalid	F	37	22	-	-
fenamiphos	I	34.8	21	-	-
p,p'-DDE normalised	I	18.2	**2.6**	1.4	7
prometryn	H	17.4	15	-	-
p,p'-DDT normalised	I	13.6	**2.7**	1.2	5
Flubendamide	I	13	5.7	-	-
metolachlor	H	10.9	10	-	-
Methabenzthiazuron	H	8	18	-	-
simazine	H	6.5	5	-	-
Bifenthrin	I	4.5	5	-	-
linuron	H	4.3	2	-	-
pirimicarb	I	4.3	1	-	-
diuron	H	2.2	28	-	-
oxadixyl	F	2.2	5	-	-
pyrimethanil	F	2.2	3	-	-
myclobutanil	F	2.2	2	-	-
triadimenol	F	2.2	2	-	-
cyprodinil	F	2.2	5	-	-

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Key Findings to Date

- Levels of heavy metals, hydrocarbons and organotins present a low risk
- Pesticide concentrations are of concern and pose a moderate risk to flora and fauna
- Storm events increase the risk of pesticide exposure, increased rainfall links with increased pesticide occurrence and concentrations
- Herbicides and fungicides are most frequently detected pesticides and occur at highest concentrations.
- Environmental concentrations of herbicides pose risk of toxicity for seagrasses and mangrove seedlings
- Pesticides are primarily associated with agricultural land use and are causing biological impacts
- No site-specific impacts apparent in fish, although fish show signs of general stress

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Future directions and opportunities

Toxicants:

5.1 Assess occurrence of pesticides in surface waters and sediments within additional sub-catchments. ✓

5.2 Investigate pesticide effects on key fauna and flora of Western Port with a view to developing Western Port specific toxicant guidelines.

5.3 Assessment of risks from new and emerging contaminants: Pharmaceuticals and personal care products (PCPPs).

5.4 Investigate the role of farming practices on the transport of pesticides to Western Port Waterways.

Fish:

5.5 Fish surveys to be conducted more broadly throughout Western Port and additional external reference sites. ✓

5.6 Investigate health of freshwater and estuarine fish

5.7 Understand the connectivity of individuals and population structure of Smooth Toadfish throughout the bay ✓

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HydroNumerics

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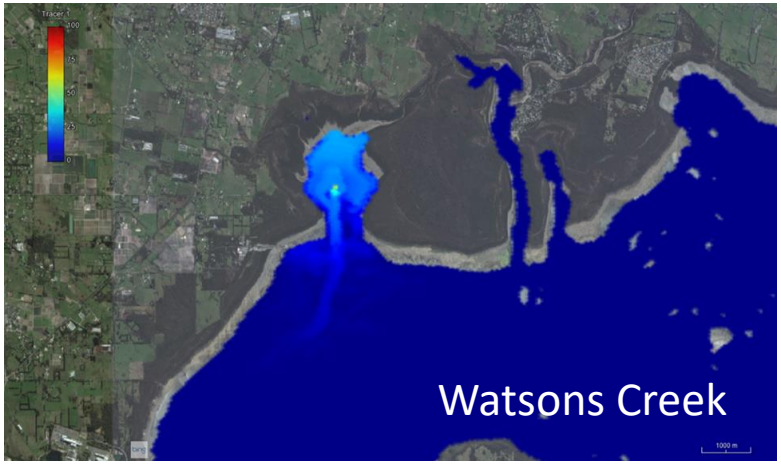
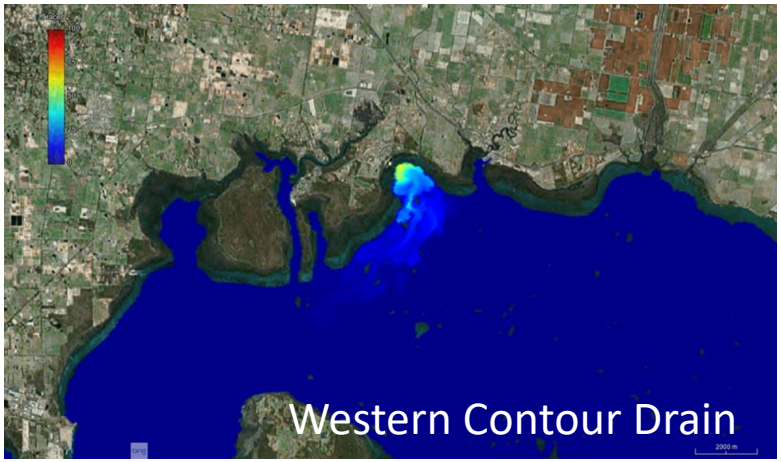
Hydrodynamic modelling





- Pesticide inputs from Watsons Creek and Western Contour Drain are likely to be localised
- Vegetation within 5km of estuary mouths may be impacted dependant on extent of mixing and initial concentrations of inflows.

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