



An Integrated Passive Sampling Approach to Detect and Identify Primary Sources of Pollution in Stormwater Networks

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David Sharley, Dan MacMahon, Simon Sharp and Steve Marshall



Point source pollution

- Single identifiable source of pollution
- Often the result of accidental discharge or deliberate disposal
- Isolated or consistent - consistent pollution events are the most serious
 - Stormwater pipes (discharge into creek)
 - Businesses (discharge into pipes)
 - Illegal discharges
 - Structural or waste fires



Multiple
scales

Stormwater pollution

Types of pollutants:

- Heavy metals
- Petroleum hydrocarbons
- Polyaromatic hydrocarbons
- Pathogens (bacteria, viruses)
- Pesticides
- Persistent organic pollutants (dioxins, PCBs)
- Suspended and dissolved solids



Impacts of pollution

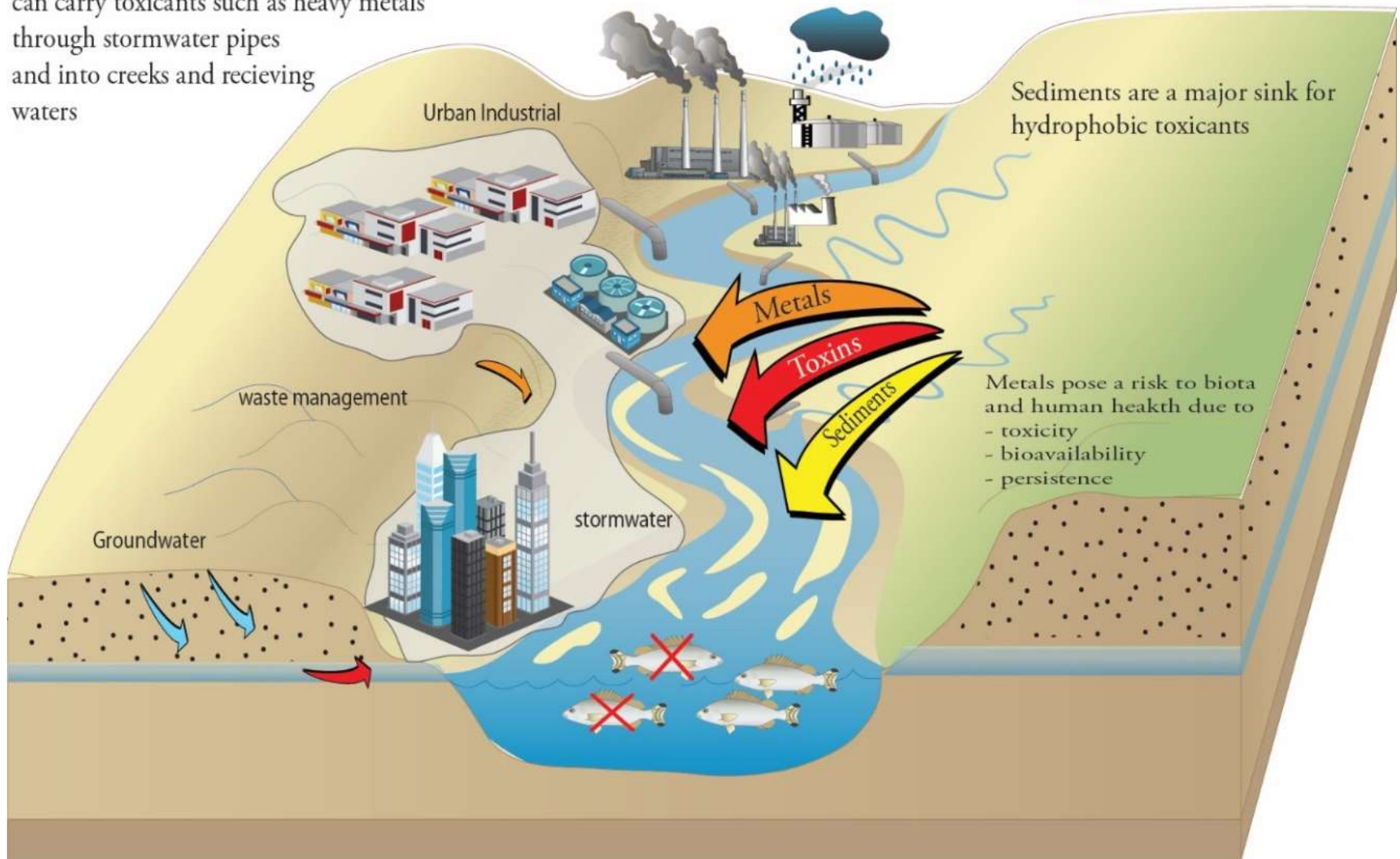
Point source pollution can lead to both acute and chronic impacts:

- Ecological
- Human
- Economic
- Social



Stormwater originating from industrial areas can carry toxicants such as heavy metals through stormwater pipes and into creeks and receiving waters

Industrial Pollution



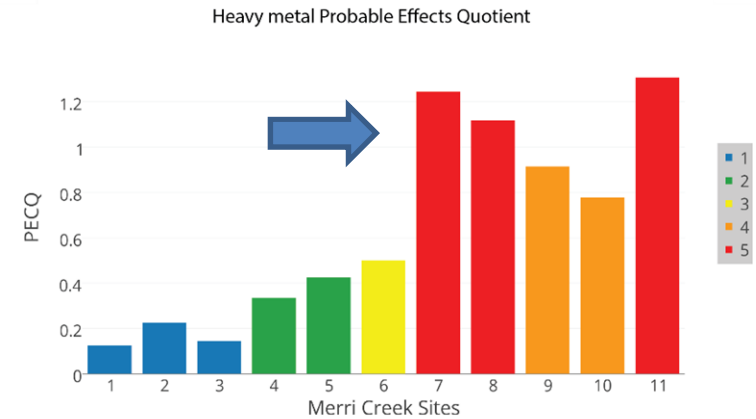
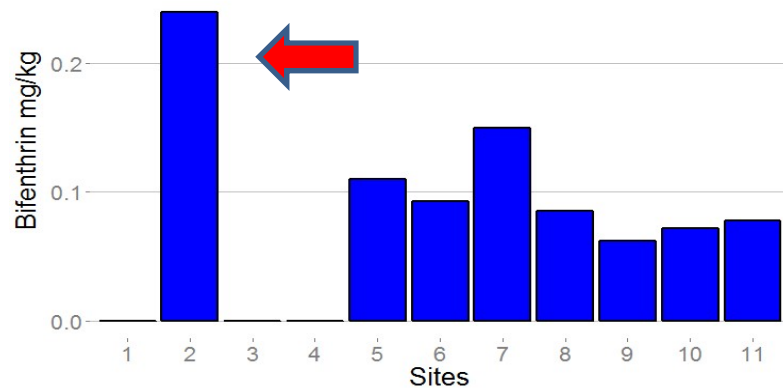
Pollutants accumulate in sediments where they can have long-term ecological impacts

Ecological Impact

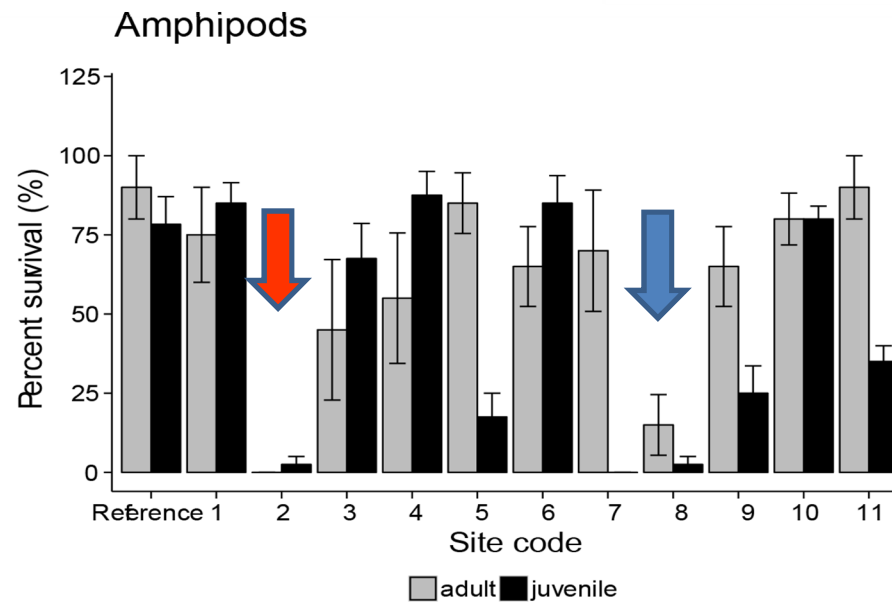
- Local stress on aquatic fauna
 - Loss of species
 - Changes in aquatic communities
 - Bioaccumulation within fish
 - Fish deaths
- Sub-lethal effects
 - Fecundity or reproductivity
 - Growth
 - Fish lesions



Drains along an urban creek



Creek sediment
Ecotoxicological
results



Health Impacts



Storm water pollution from industrial areas impacts downstream wetlands

- it only takes ~10% of a catchment to be industrialised for stormwater to significantly pollute downstream receiving wetlands
- Reducing pollution from industrial areas will:
 - protect downstream wetlands
 - reduce management costs to Melbourne Water / Local Government
- Contaminated sediment clean up costs
Wetland sediment contamination
Estimated to be \$500 m over 20 years



Sharley, D. J., Sharp, S. M., Marshall, S., Jeppe, K., Pettigrove, V. J., 2017, Linking urban land use to pollutants in constructed wetlands: Implications for stormwater and urban planning, Landscape and Urban Planning 162:80-91.



Photo Courtesy: Dandenong City Council



Engine oils not contained
& no spill kit.

Photo Courtesy: Dandenong City Council



24.03.2016 09:30

Photo Courtesy: Dandenong City Council

Traditional Stormwater Sampling

- Contaminant concentrations vary over time
- Analysis expensive when taking numerous grab samples
- Pollutants often have low water solubility – not detected in stormwater
- Costly equipment for auto-sampling and requires power



Subterranean Stormwater Drains

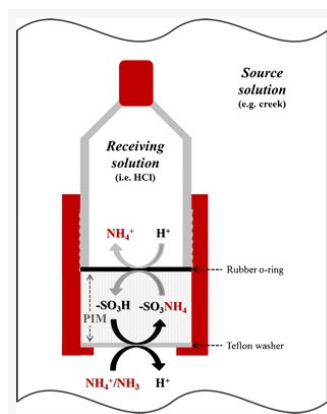
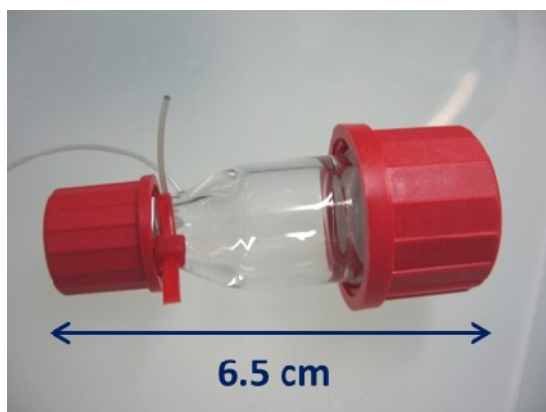
The subterranean nature of stormwater drains pose further difficulties

- confined space
- dangerous
- expensive
- deep
- sporadic flows



Stormwater Passive Sampling

PIMs based passive sampling device can measure ammonia in water – microbial pollution



Granular Activated Carbon (GAC) for metals and hydrocarbons in stormwaters.

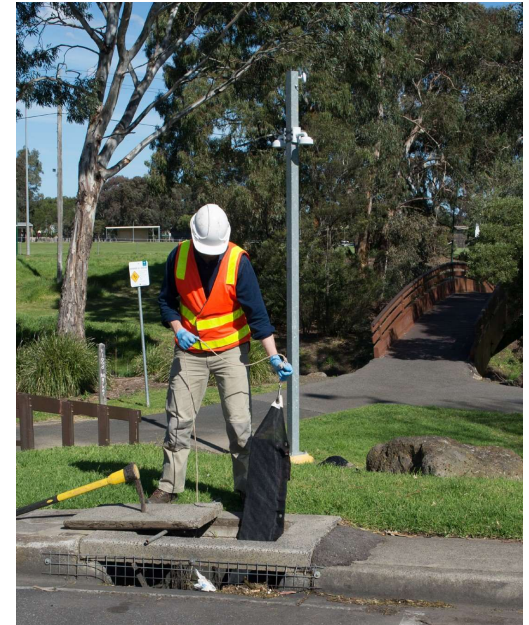


In drain suspended particle sampler – pesticides, and POP's in stormwater

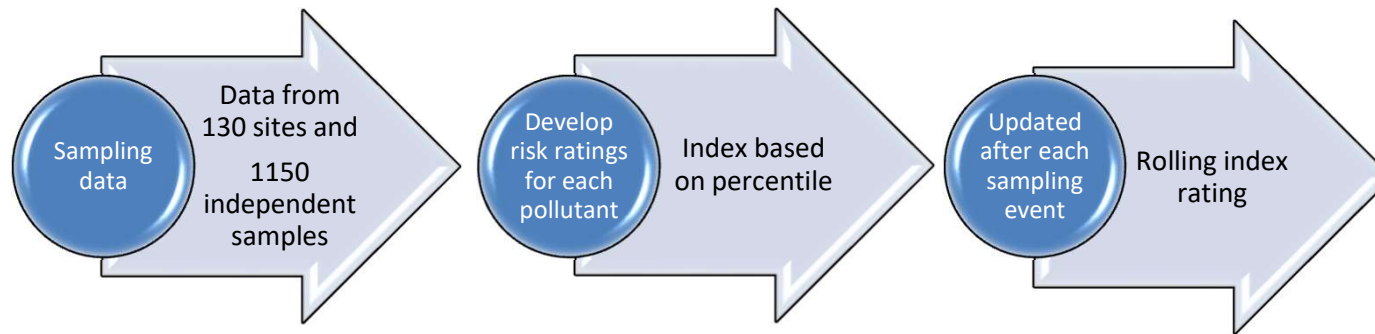


Passive Sampling Solutions

- Allow episodic events to be captured
- No power required
- Cost-effective
- Allow multiple samplers to be deployed across a catchment at the one time.



Passive sampling pollutant index



Individual pollutant risk rating		
percentile	Risk rating	individual score
>90	Extreme	5
90	Very High	4
75	High	3
60	Medium	2
40	Low	1

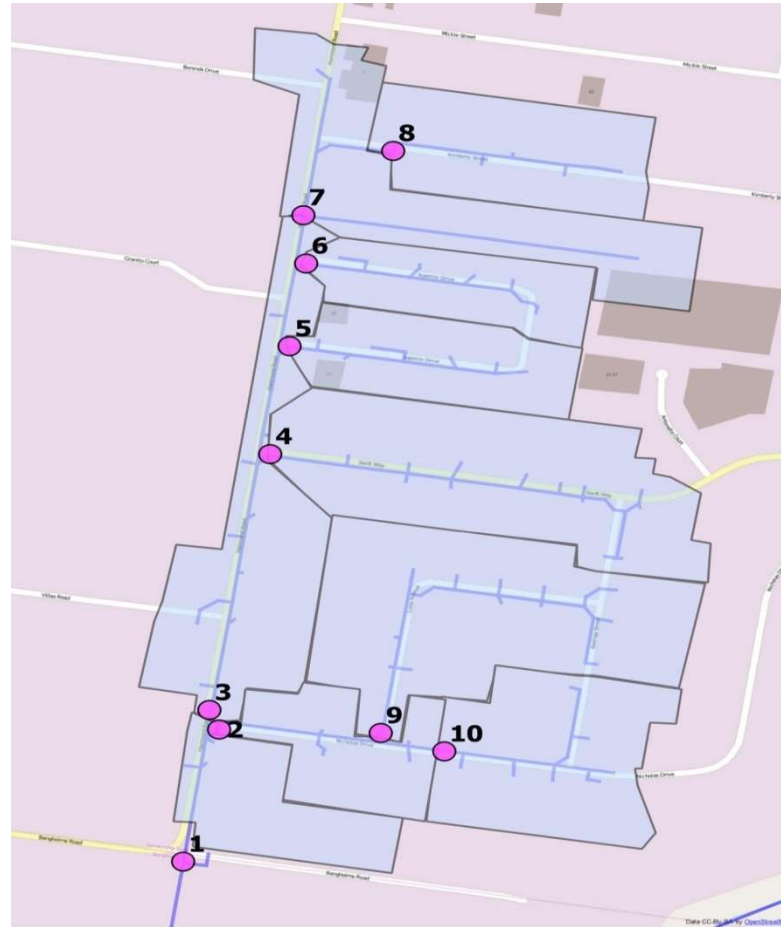
Site score	
Extreme	27
Very High	22
High	15
Medium	9
Low	7



site	Cr	Cu	Pb	Ni	Zn	TPH	BTEX	Total score	Site Risk rating
1	1	1	1	1	1	1	1	7	Low
2	1	2	3	3	3	1	1	12	Medium
3	1	1	1	1	1	4	1	10	Medium
4	2	3	5	3	4	5	5	27	Extreme
5	1	1	1	2	4	1	1	11	Medium
6	1	4	3	4	5	4	1	22	Very High

High pollution in local wetlands and creeks

Point source investigation

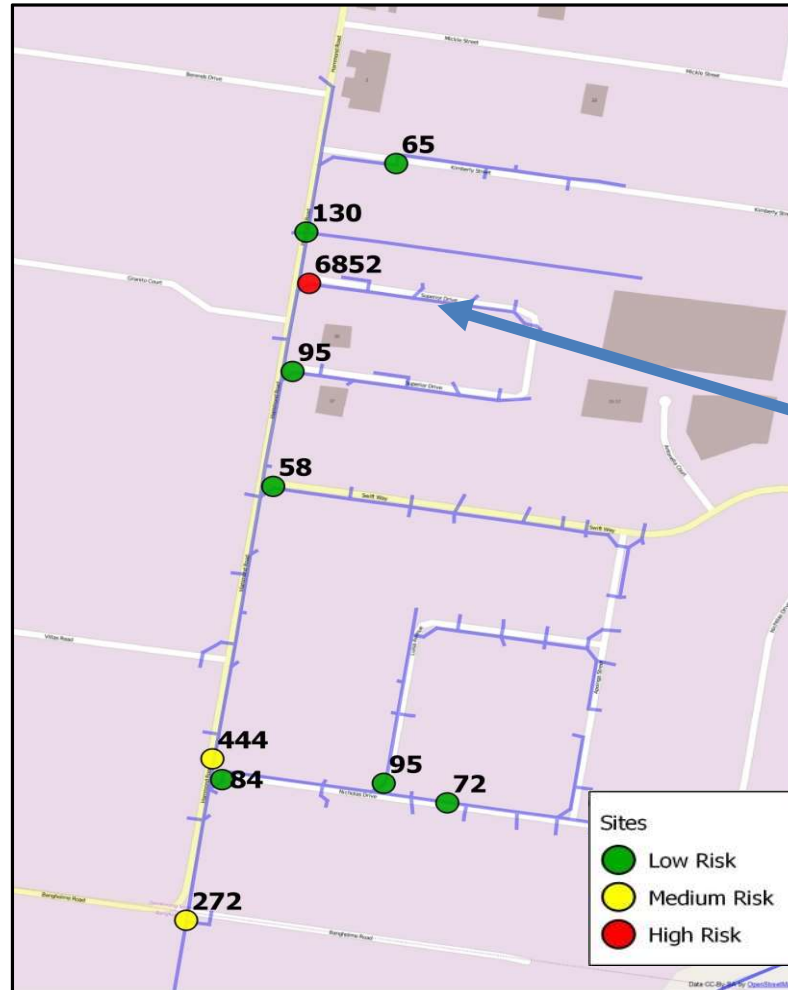


Stormwater drains ———

Passive sampling locations ●

High pollution in local wetlands and creeks

One sub-catchment was discharging high concentrations of chromium



EPA investigations and audits conducted on local businesses

Stormwater drains

High mercury in local wetland

Identified through
sediment surveys



point-source
pollution program
initiated



Mercury
contamination

Constructed
wetland

Stormwater drains

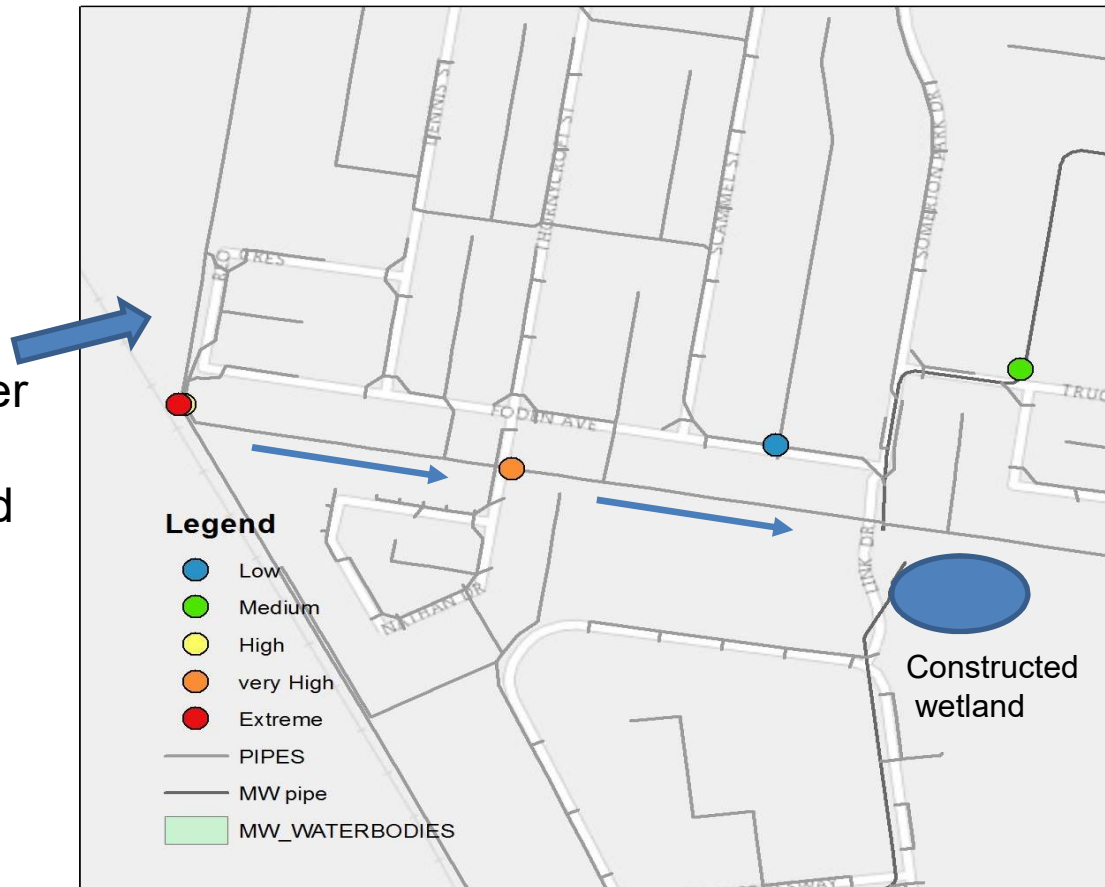


Passive sampling locations



High Mercury in local wetland

EPA investigation
found business
polluting stormwater
Drains:
Fines were issued



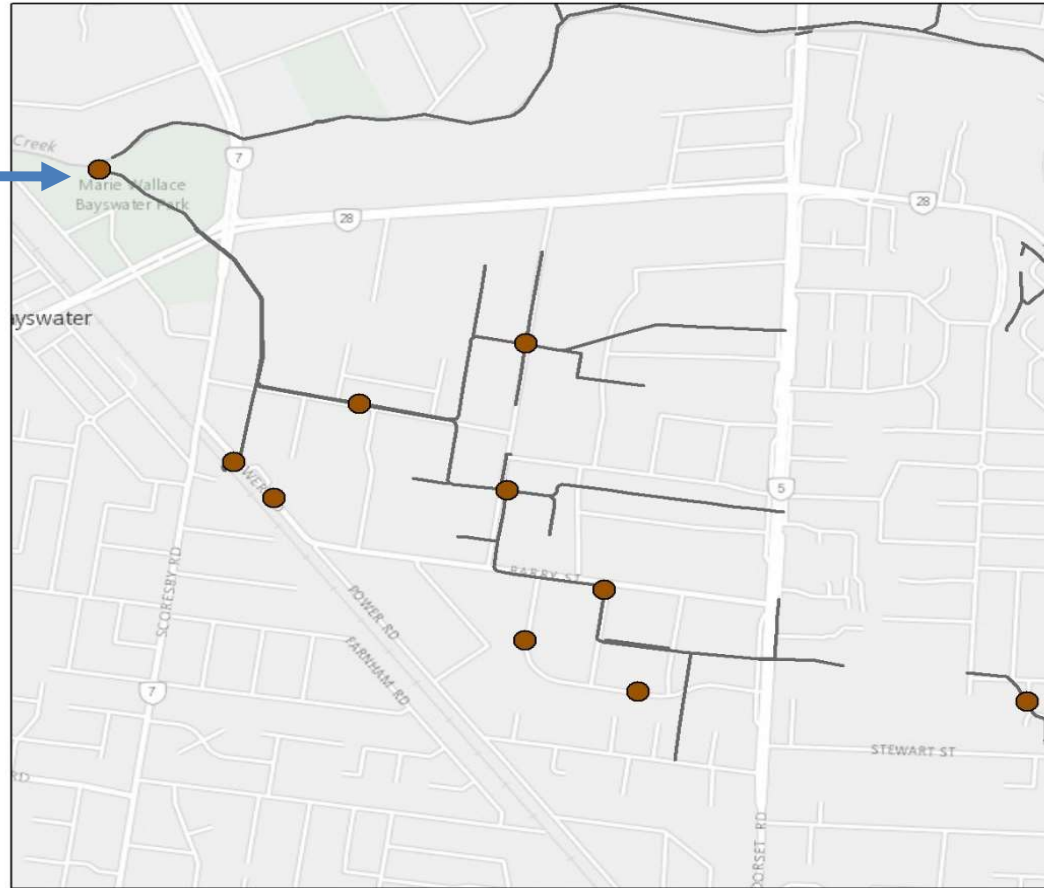
Wetland
dredged
at very high
cost to
Melbourne
Water

Stormwater drains

Silver was found to be contaminating Dandenong Creek

Silver contamination in creek sediment – annual sediment surveys

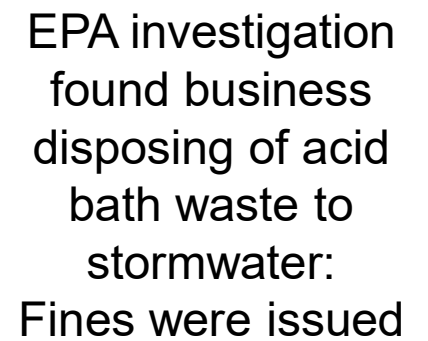
point-source pollution program
Initiated in industrial area to find source of silver



Stormwater drains

Passive sampling locations

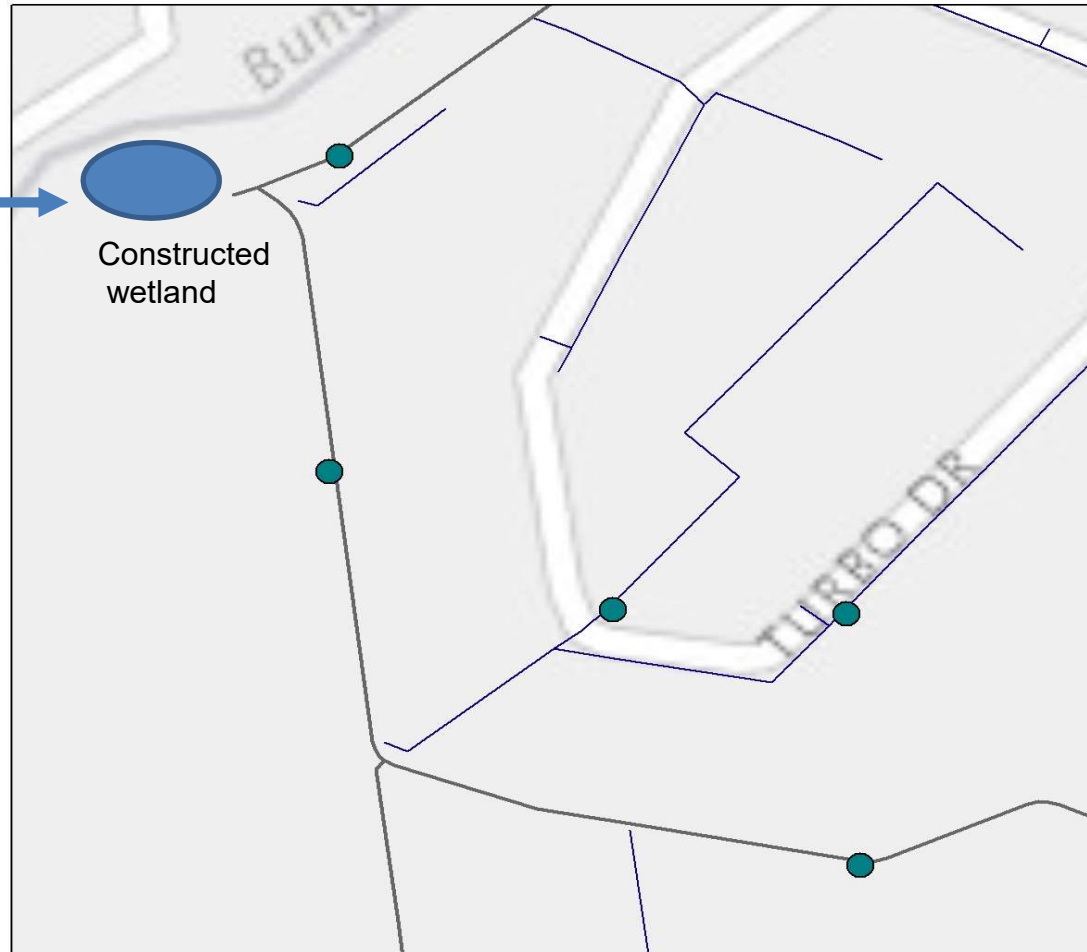




Passive sampling locations 

Synthetic pyrethroid pollution

High concentrations of permethrin was found in constructed wetland - annual surveys



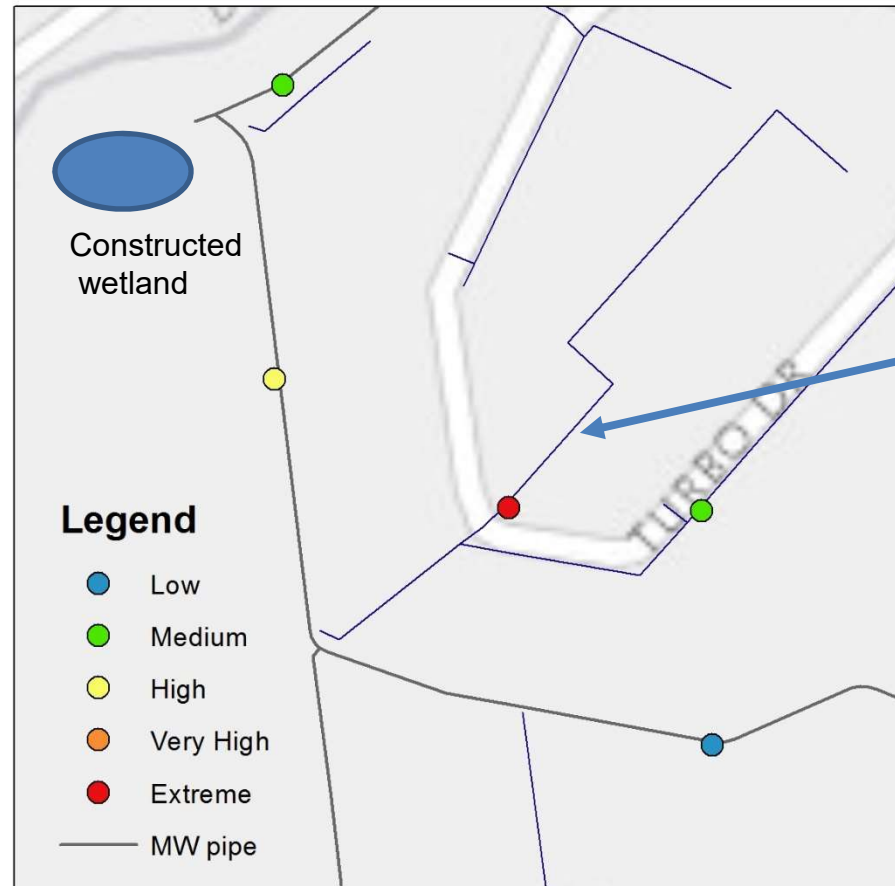
point-source pollution program Initiated in industrial area to find source of permethrin

Stormwater drains 

Passive sampling locations 



Synthetic pyrethroid pollution



Investigation found business that used permethrin in their manufacturing processes discharged their manufacturing waste to stormwater

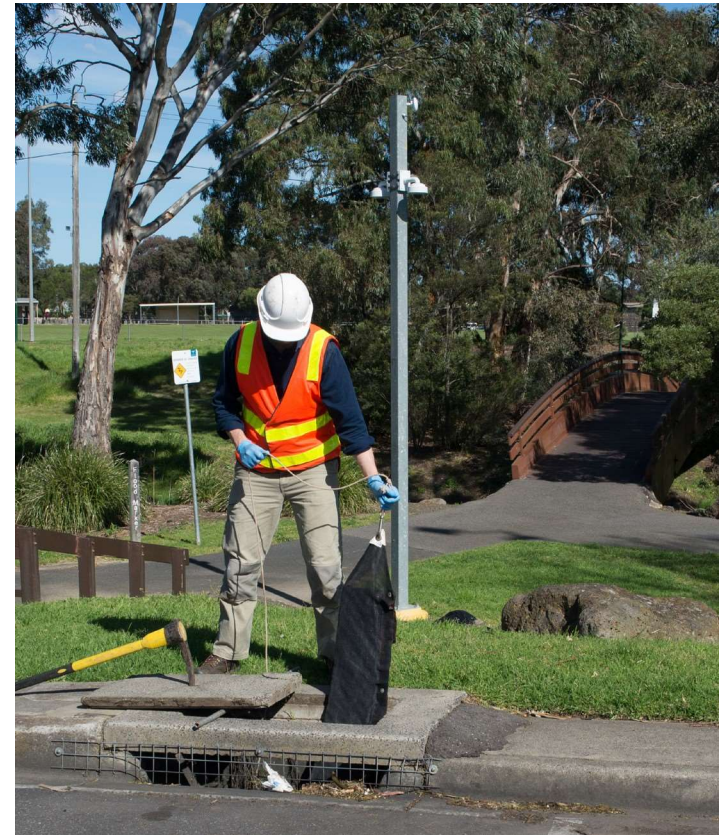
Investigations are on-going

Stormwater drains ———

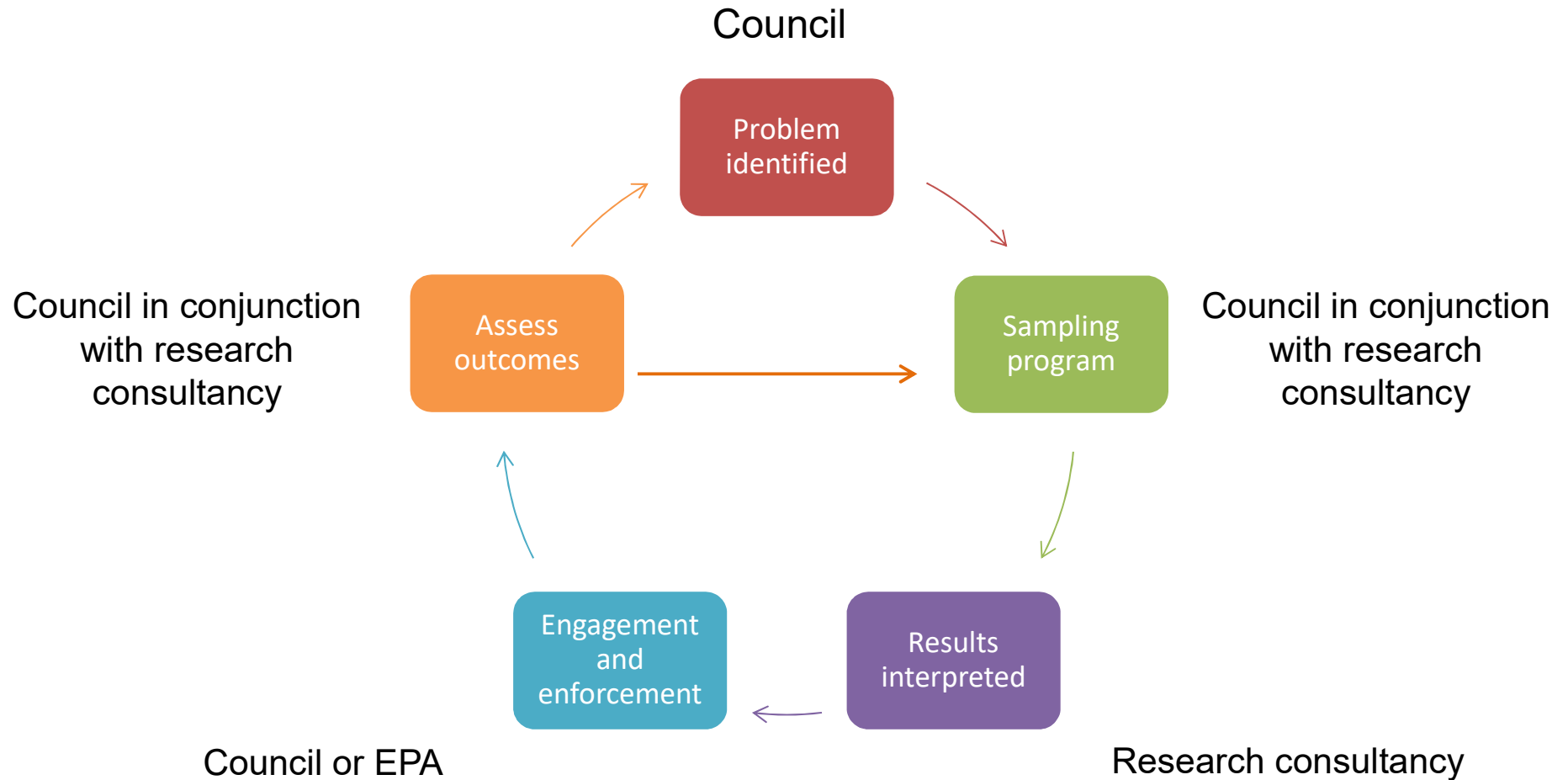
Passive sampling locations ●

Research consultancy support

- **Council and EPA Engagement and Enforcement Programs (EEP)**
- Point source investigation design
 - how many samplers
 - Where in the catchment
- Upskilling or training of council staff in using passive samplers
- Provision of passive sampling devices
- Analysis of samples
- Interpretation of results
- Reporting and recommendations



Pollution Identification Work Flow



Acknowledgements

- Melbourne Water for funding initial Hot Spots program in 2012-13 and their on-going support through the Living Rivers program
- Local councils that have supported the development of the stormwater passive sampling programs across Melbourne
 - Whittlesea City Council
 - Dandenong City Council
 - Hume City Council
 - Mornington Peninsula Shire



Contact David Sharley: d.sharley@gmail.com

Social

- Recreational water use
 - Beach closures
 - Fishing
- Aesthetics
 - Litter
 - Hydrocarbons
 - Odours

