CRC for
Water Sensitive Cities

“城市适应气候变化国际研讨会”2014.9.05

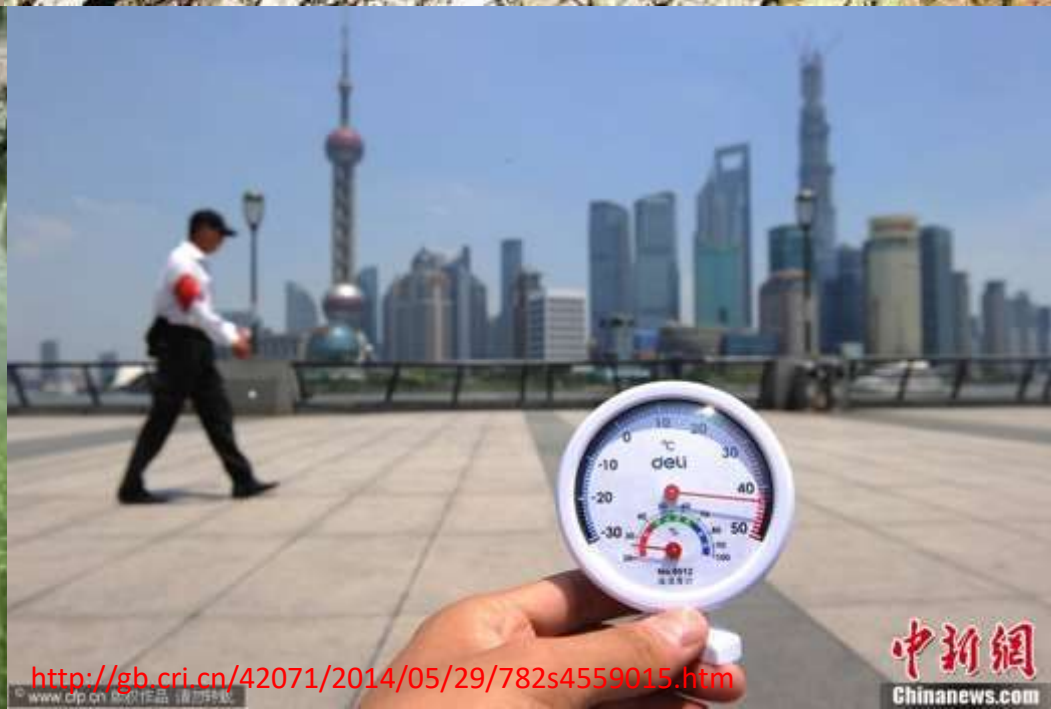
在气候变化和极端天气背景下建设城市水资源环境的战略安全

王健斌
澳大利亚水敏型城市合作研究中心
Corporative Research Centre for Water Sensitive Cities

An Australian Government Initiative

CRC AUSTRALIA

http://www.wenzhousx.com/weather/zixun/55686.html



http://gb.cri.cn/42071/2014/05/29/782s4559015.htm

气候变化对城市的影响

- **drought and water scarcity**
  持续干旱水资源短缺

- **water pollution and environment degradation**
  水体污染水环境恶化

- **urban fluvial and pluvial floods**
  洪水和内涝频繁

- **urban heat island and heat waves**
  城市热岛和高温热浪

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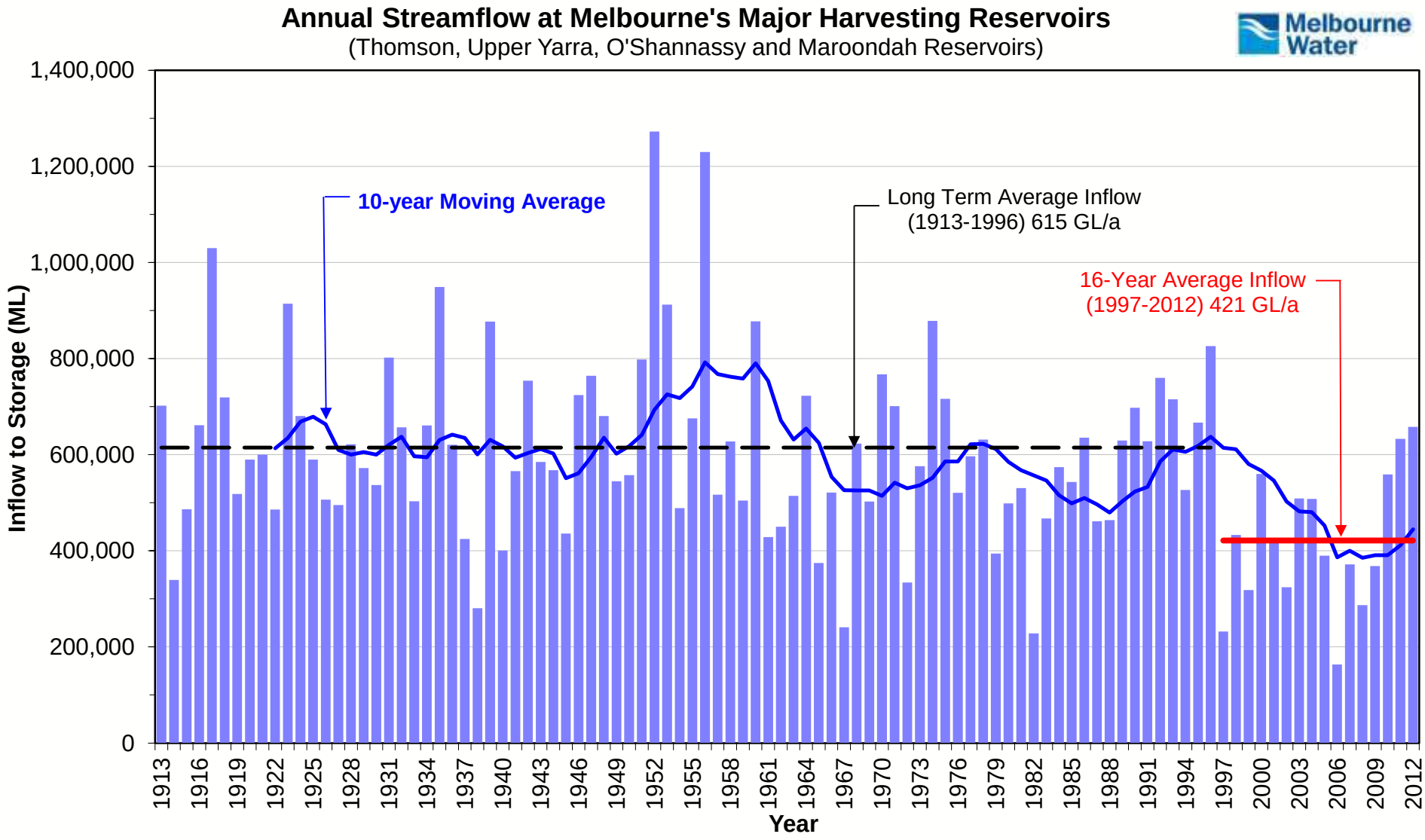
Thomson Dam 1997

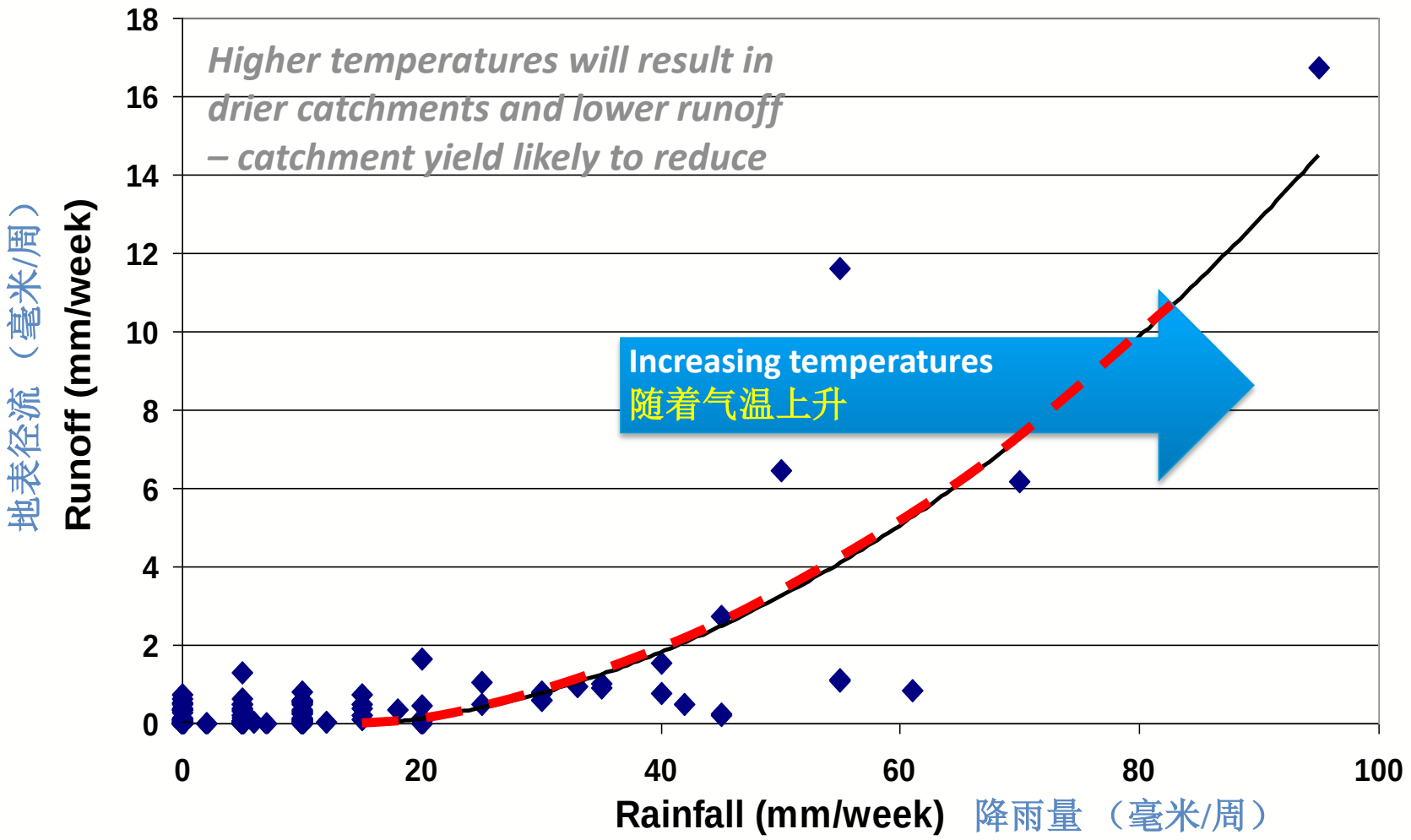

Thomson Dam 2008

每年流入墨尔本饮用水库的流量



http://www.melbournewater.com.au/waterdata/waterstorages/Pages/Inflow-over-the-years.aspx

饮用水库的地表径流量



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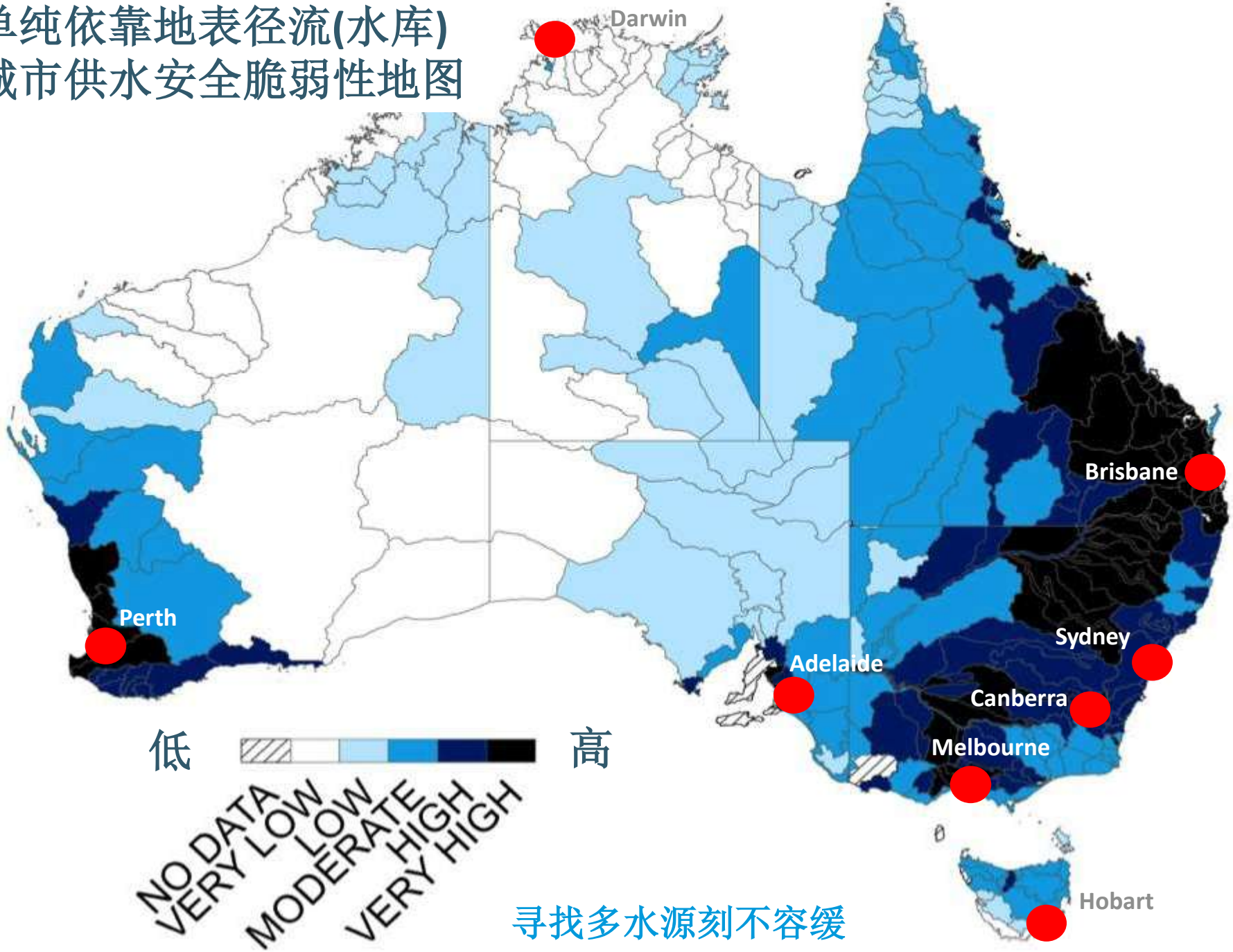
单纯依靠地表径流(水库)
城市供水安全脆弱性地图



寻找多水源刻不容缓

气候变化对城市的影响

- drought and water scarcity
  持续干旱水资源短缺
- water pollution and environment degradation
  水体污染水环境恶化
- urban fluvial and pluvial floods
  洪水和内涝频繁
- urban heat island and heat waves
  城市热岛和高温热浪

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Sunbury
Melton
墨尔本
Greensborough
Melbourne
Werribee
Burwood
Ferntree Gully
Dandenong South
飞利浦海湾
Geelong
Frankston
Torquay
外海
Dromana
Hastings
French Island
© 2013 Whereis® Sensis Pty Ltd
Image Landsat
Image © 2013 TerraMetrics
© 2013 Google

藻类爆发/水环境污染

气候变化对城市的影响

- drought and water scarcity
  持续干旱水资源短缺
- water pollution and environment degradation
  水体污染水环境恶化
- urban fluvial and pluvial floods
  洪水和内涝频繁
- urban heat island and heat waves
  城市热岛和高温热浪

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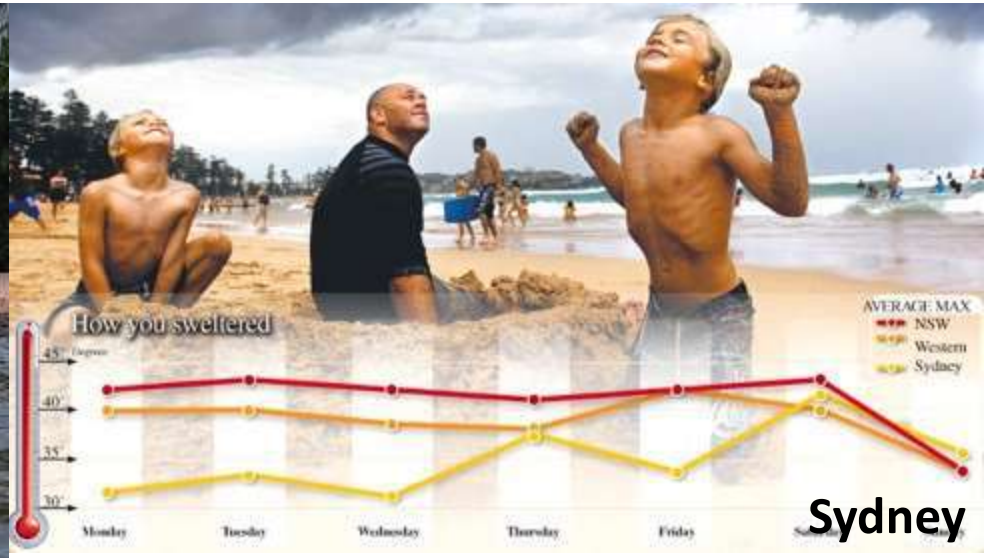
2011年1月的澳洲4大城市极端天气



城市宜居性和经济发展

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极端天气与基础设施

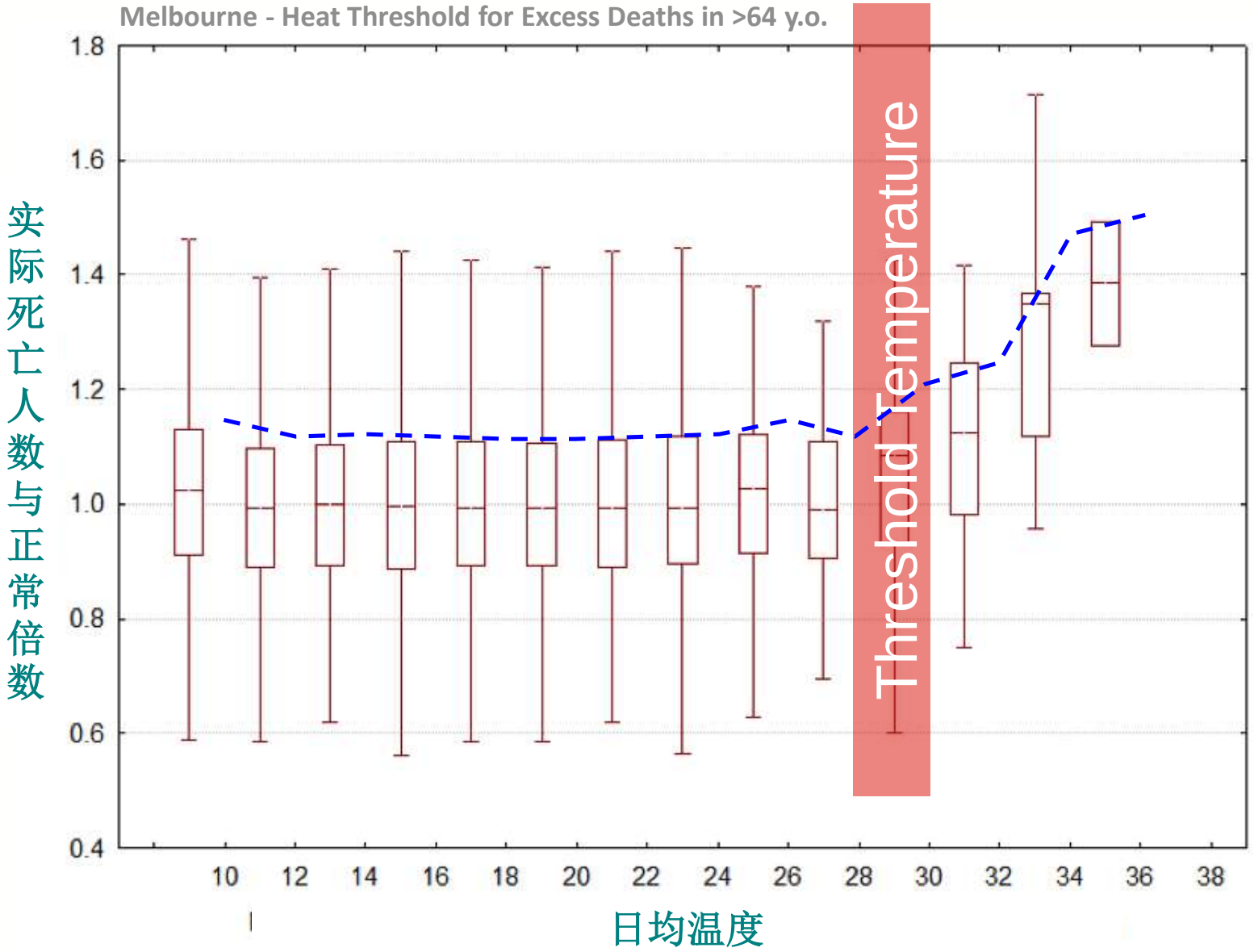
Melbourne's all-time weather record has been broken and the city is sweltering under the twin effects of high temperatures and hot north-west winds.

The city hit 46.4 degrees at 3.04pm - the hottest day since the Bureau of Meteorology started keeping records 150 years ago.

The previous record was 45.6, set on January 13, 1939 - a day otherwise known as Black Friday …
– City swelters, records tumble in heat (2009-Feb-07) [The Age]

脆弱性

极端天气与公众健康



Nicholls, Skinner, Loughnan and Tapper, 2007. Int J. of Biometeorology

Water Sensitive Cities

气候变化对城市的影响

- 持续干旱水资源短缺
- 水体污染水环境恶化
- 洪水和内涝频繁
- 城市热岛和高温热浪

Urban liveability and vulnerability
城市宜居性
城市脆弱性

城市的经济发展

Water 水

Urbanisation
城市化+人口膨胀

climate change
气候变化

2010年全世界有超过一半人口生活在城市中，这个数据在2030年达到60%，2050年将达到70%

As of 2010, globally more than half of people live in an urban area. By 2030, 6 out of every 10 people will live in a city, and by 2050, this proportion will increase to 7 out of 10 people (WHO, 2013).

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20,369,534（两千万人口） people =

59 x Canberra

59 x 堪培拉

12 x Perth

12 x 珀斯

10 x Brisbane

10 x 布里斯班

5 x Melbourne

5 x 墨尔本

5 x Sydney

5 x 悉尼

Note: Diagram shows Australia's predicted population growth to 2056 according to ABS 'series A' population projections

Source: Source: http://www.abs.gov.au/Ausstats/abs@.nsf/mf/3222.0

澳大利亚

- 传统上是个低密度国家
- 城市绿地生态系统在城市生活中占重要地位
- 同时又是个缺水的国家

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气候变化、极端天气、人口增长

- How cities adapt to climate change and increase resilience?

(1)城市怎样保障水安全（适应力与弹性）？

- How we densify our cities without retrofitting or augmenting our infrastructure?

(2)在城市高密度化的同时，如何更有效的利用水基础设施？

- How we densify our cities while still maintain the standard of living ?

(3)怎么在城市高密度化的同时，维系足够的宜居性？

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应对气候变化—水敏型城市应对方案 Water Sensitive City

- integrate various sources of water;， operate through a combination of centralised and decentralised systems;

  整合各种可利用的水资源，通过集中式和分散式的混合系统来灵活运行

- integrate into urban design, deliver a wider range of services to communities (e.g. ecosystem services, urban heat mitigation);

  与城市规划设计的整合，为城市提供生态系统服务——多功能绿色基础设施

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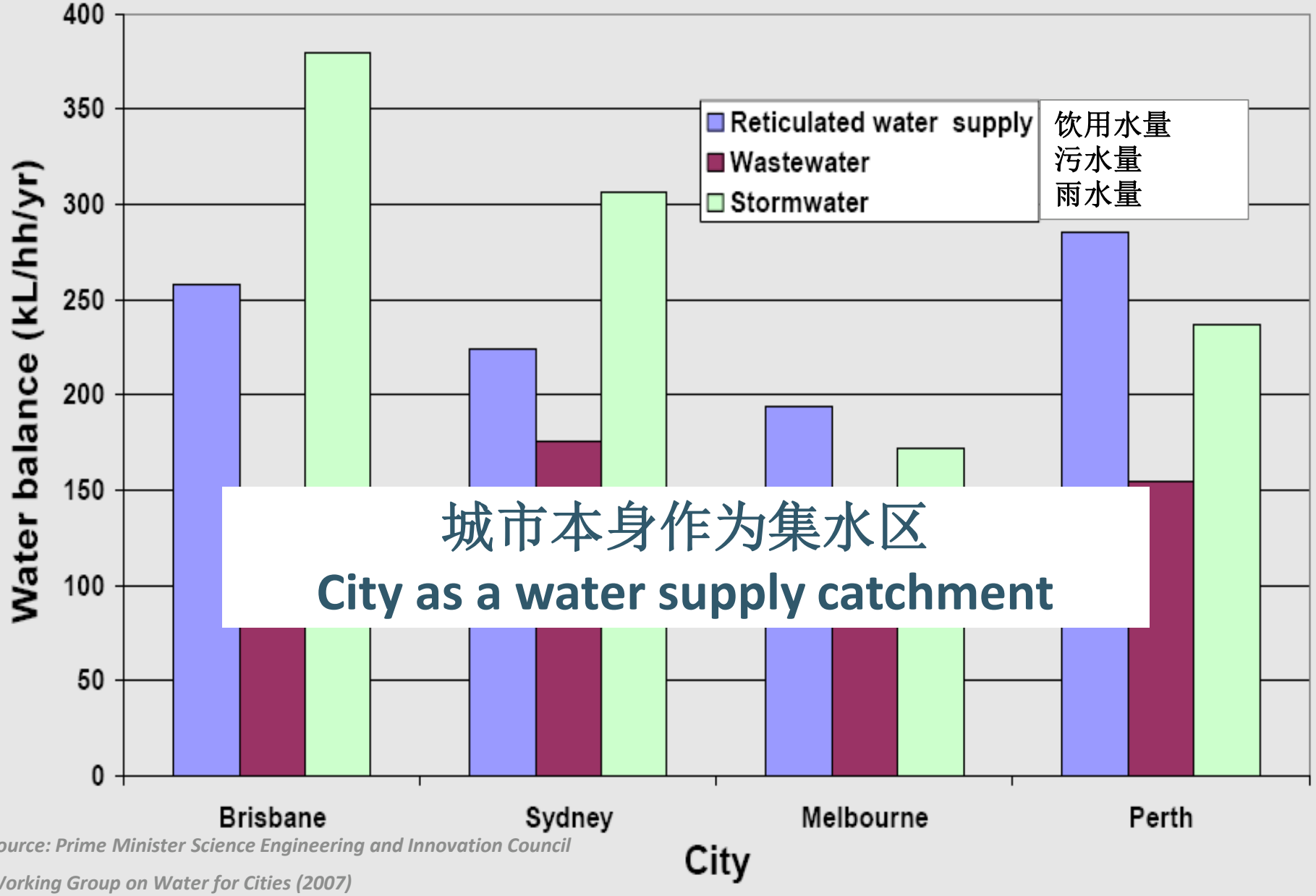
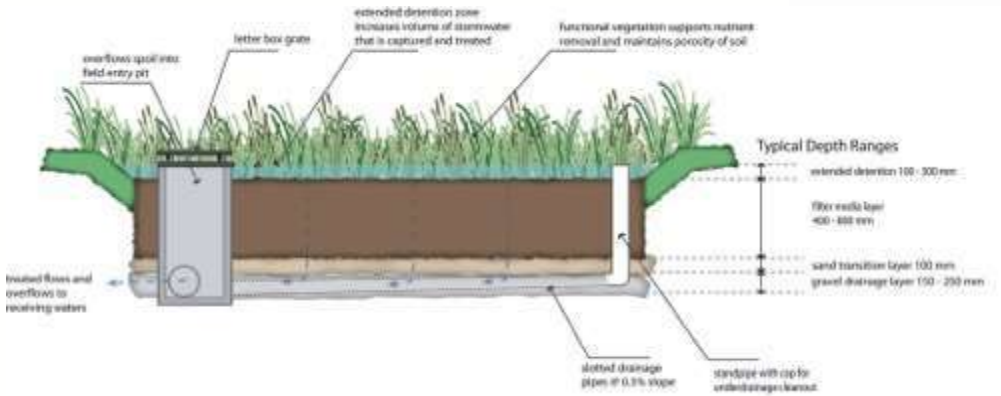
水敏型城市——雨洪水和污水作为资源

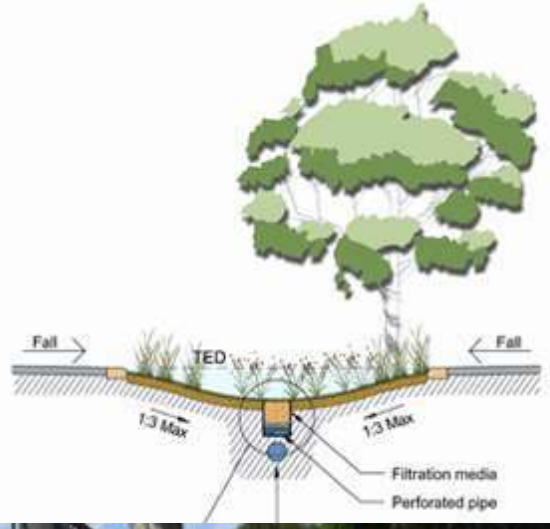


城市本身作为集水区
City as a water supply catchment

Source: Prime Minister Science Engineering and Innovation Council Working Group on Water for Cities (2007)

Lynbrook Estate Bioretention Swale 墨尔本中分带雨水处理 1995





水敏型城市蓝绿走廊

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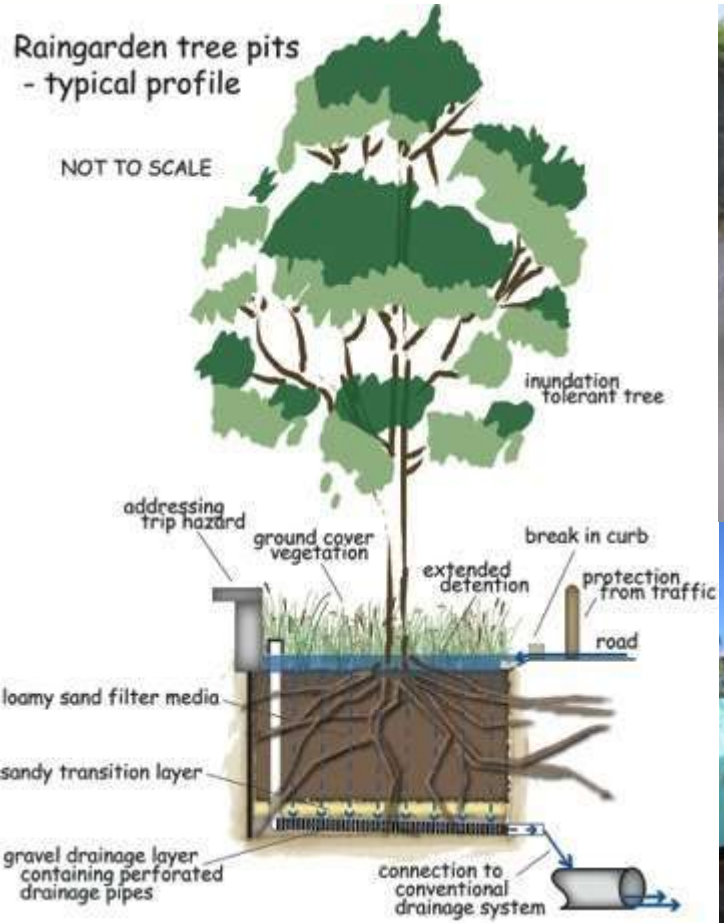
Melbourne Street Tree Bioretention 墨尔本雨水处理树箱



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Royal Park Wetland 墨尔本皇家公园湿地 2005

TSS reduction 90%
TP reduction 80%
TN reduction 50%

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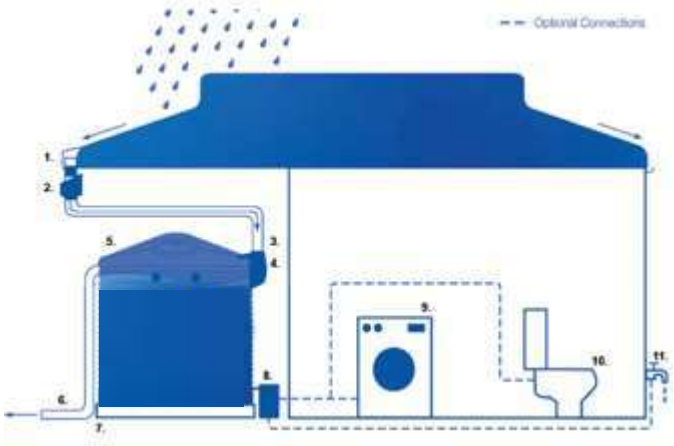
水敏型城市——缓解城市内涝

- Source control plays an essential role and Community awareness and preparedness – living with flood

❑源头控制– 绿色建筑，智能雨水收集系统

Talking tanks
District stormwater Harvesting and retention
智能控制的区域联合雨水收集、滞留、回用系统



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水敏型城市——缓解城市内涝

把低洼地区改造成**城市公园或城市森林**，晴天供人们使用，雨天作为城市排水系统的一部分

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水敏型城市——缓解城市内涝

- A water sensitive city would establish **a network of blue and green open spaces and corridors to serve as an integral element of the city's drainage infrastructure** and floodway for flood conveyance during rare (low probability) storm occurrences.

- 由**蓝色绿色走廊**和**绿色开放空间**组成的生态网络，为城市日常排水基础设施，在极端降雨环境下的安全排洪通道

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April 2000


2003 生态走廊

水敏型城市— 蓝绿走廊城市重要的绿地系统和行洪通道

- 土地利用和城市内涝防治
- 合理的城市规划和设计

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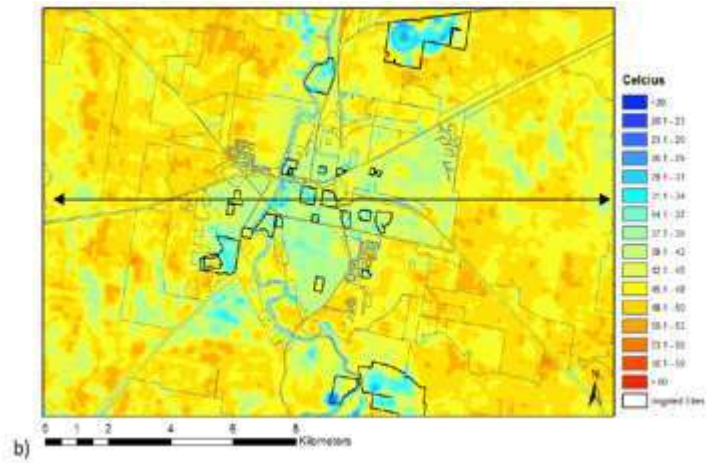
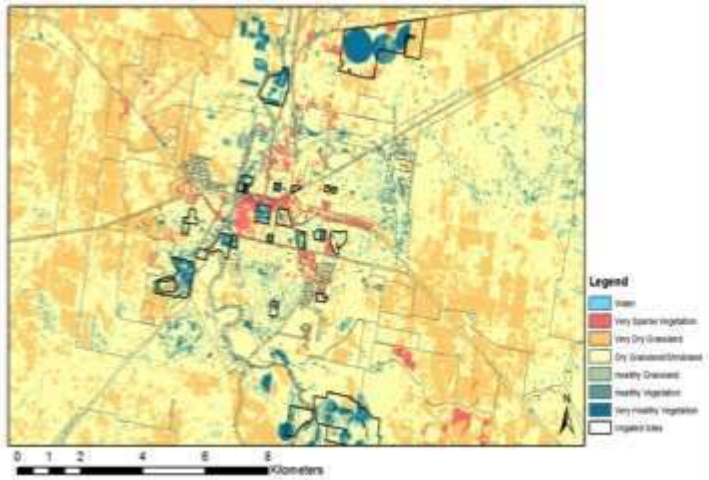
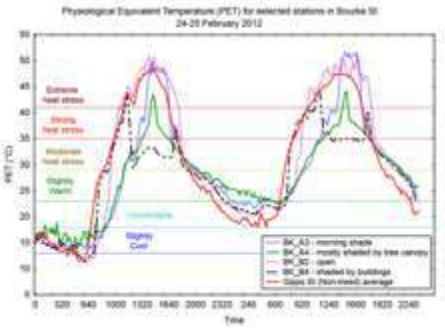
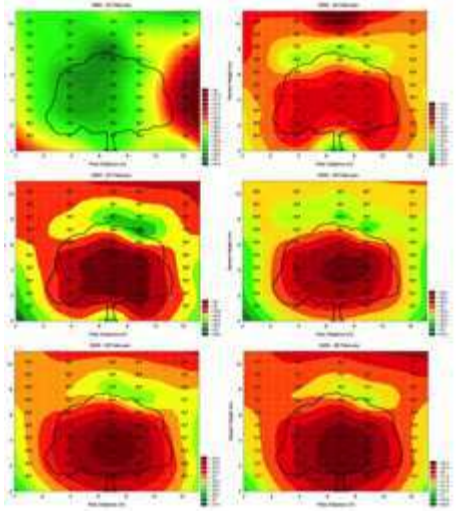
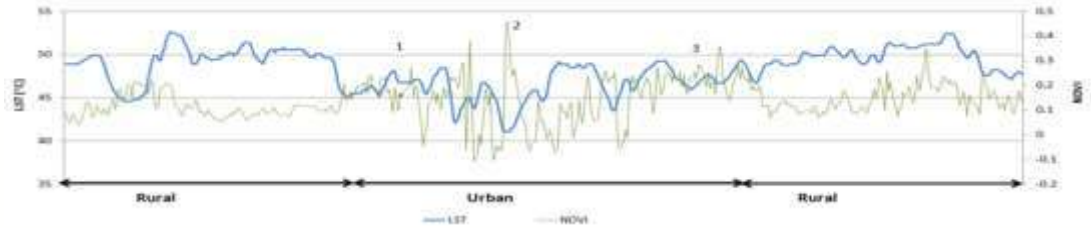
水敏型城市——利用水和绿色基础设施为城市降温











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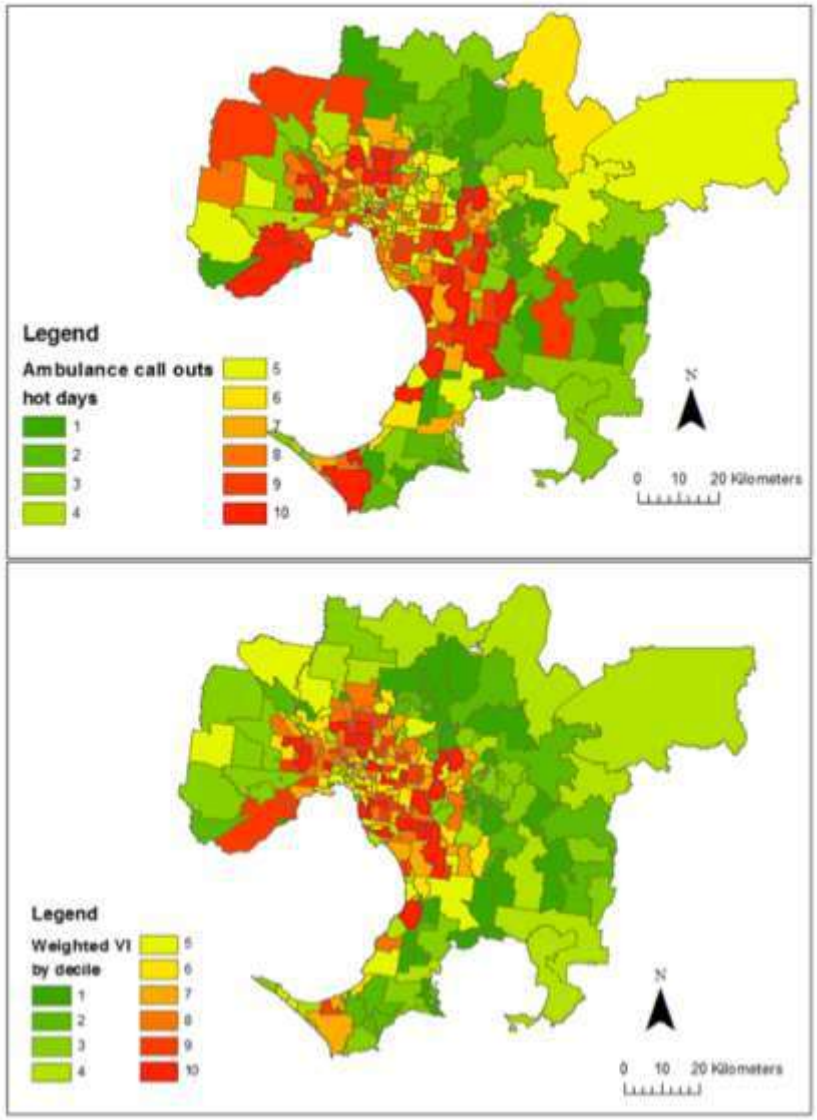
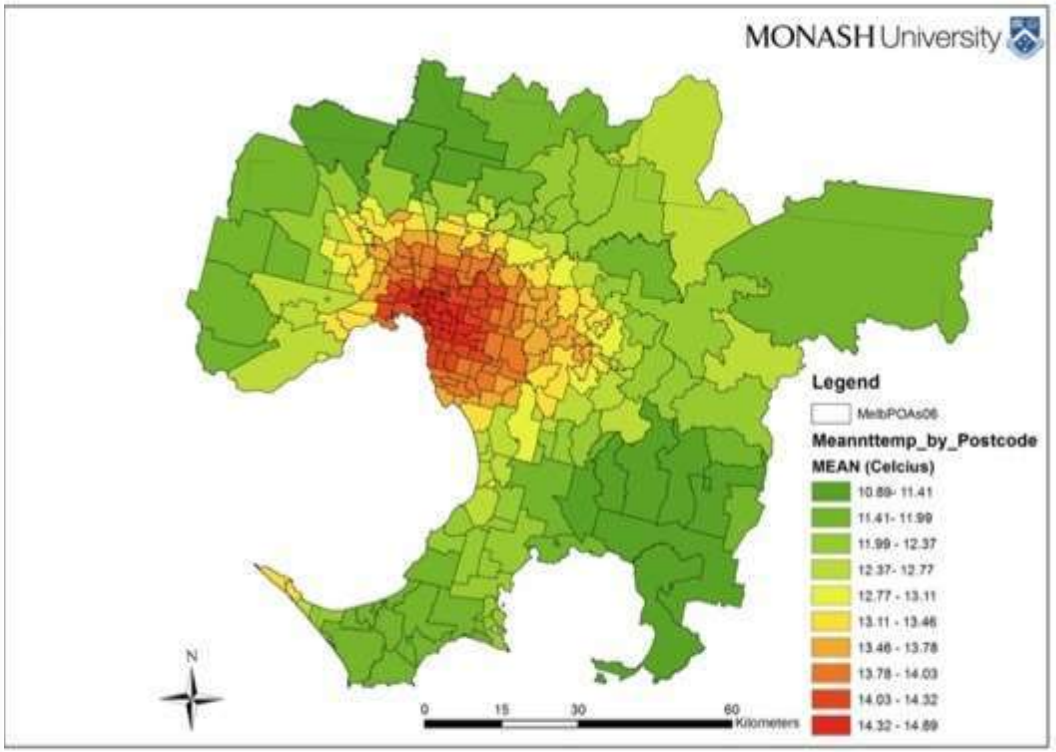
水敏型城市– 通过城市规划设计实施整合策略



墨尔本热脆弱地图



Loughnan, Tapper et al., 2013

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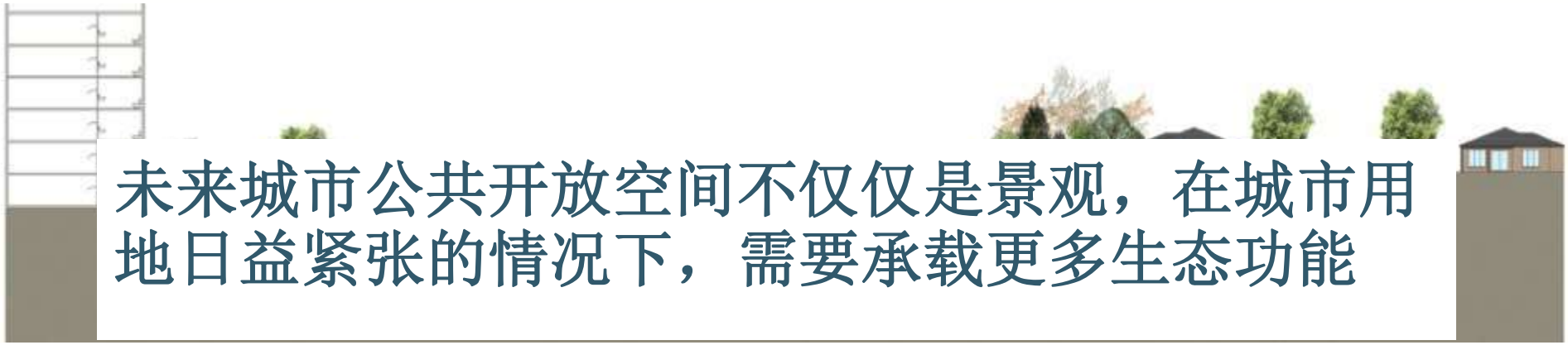
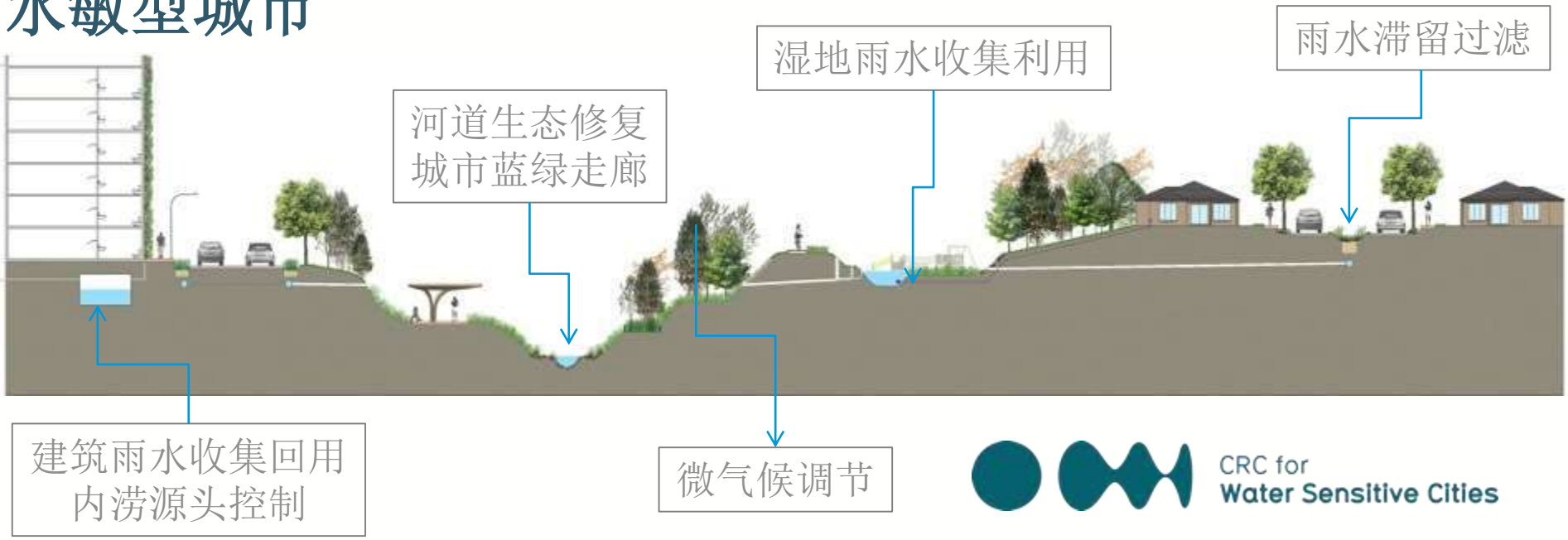
水敏型城市—多功能基础设施 Water Sensitive Urban Design

传统城市



未来城市公共开放空间不仅仅是景观，在城市用地日益紧张的情况下，需要承载更多生态功能

水敏型城市



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水敏型城市—集中式分散式混合

Spatial Scales 空间尺度

LOT
建筑尺度

NEIGHBOURHOOD
街区尺度

SUBURB/CATCHMENT
区域尺度

CITY
城市尺度

DECENTRALISED
分散式基础设施

CENTRALISED
集中式基础设施

分散式缓解集中式压力
集中式给分散式提供保障

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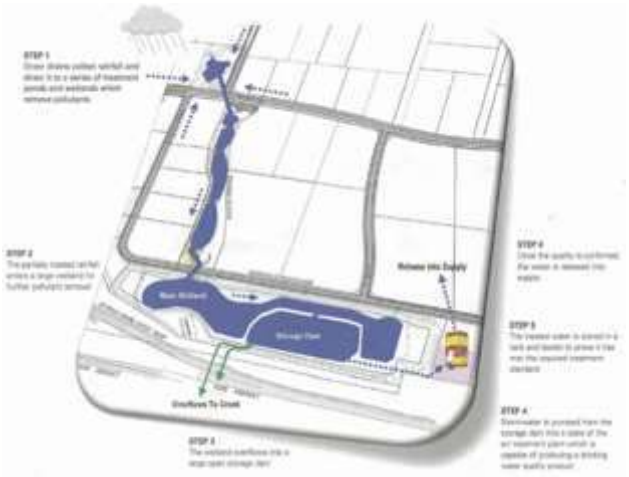
水敏型城市—集中式分散式混合

Stormwater harvesting and reuse

分散式区域雨水收集回用系统



Kalkallo Stormwater Harvesting and Reuse Project is one of international significance, with the ultimate possibility of supplementing the Kalkallo region's local drinking water supply with treated stormwater.

- 每年从墨尔本中央商业区收集36.5万吨雨水
- 供给区域的非饮用水
- 最终扩展成同时供给饮用水和非饮用水

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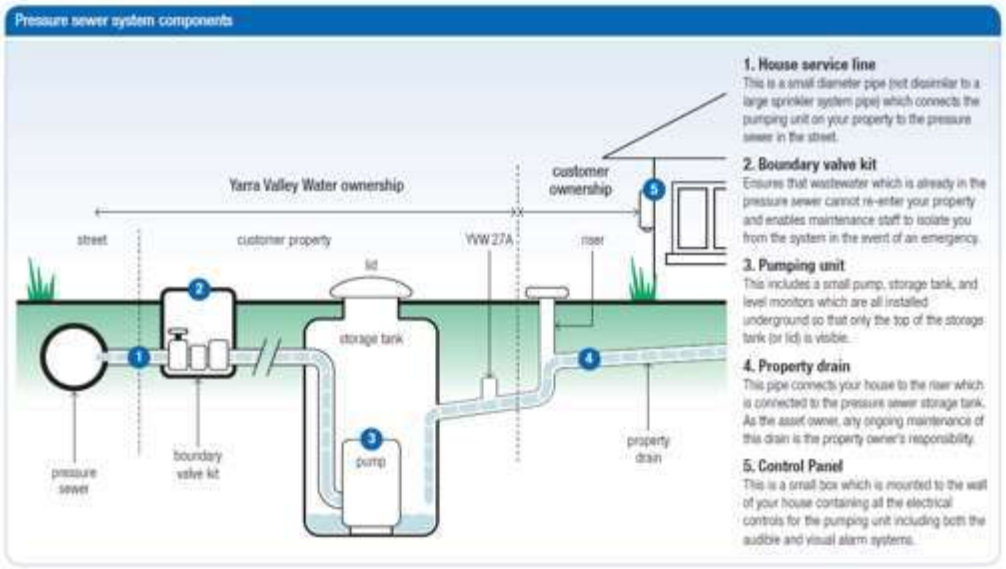
水敏型城市—集中式分散式混合

Smart Sewer智能污水系统



Decentralised sewer mining分散式污水回收利用系统

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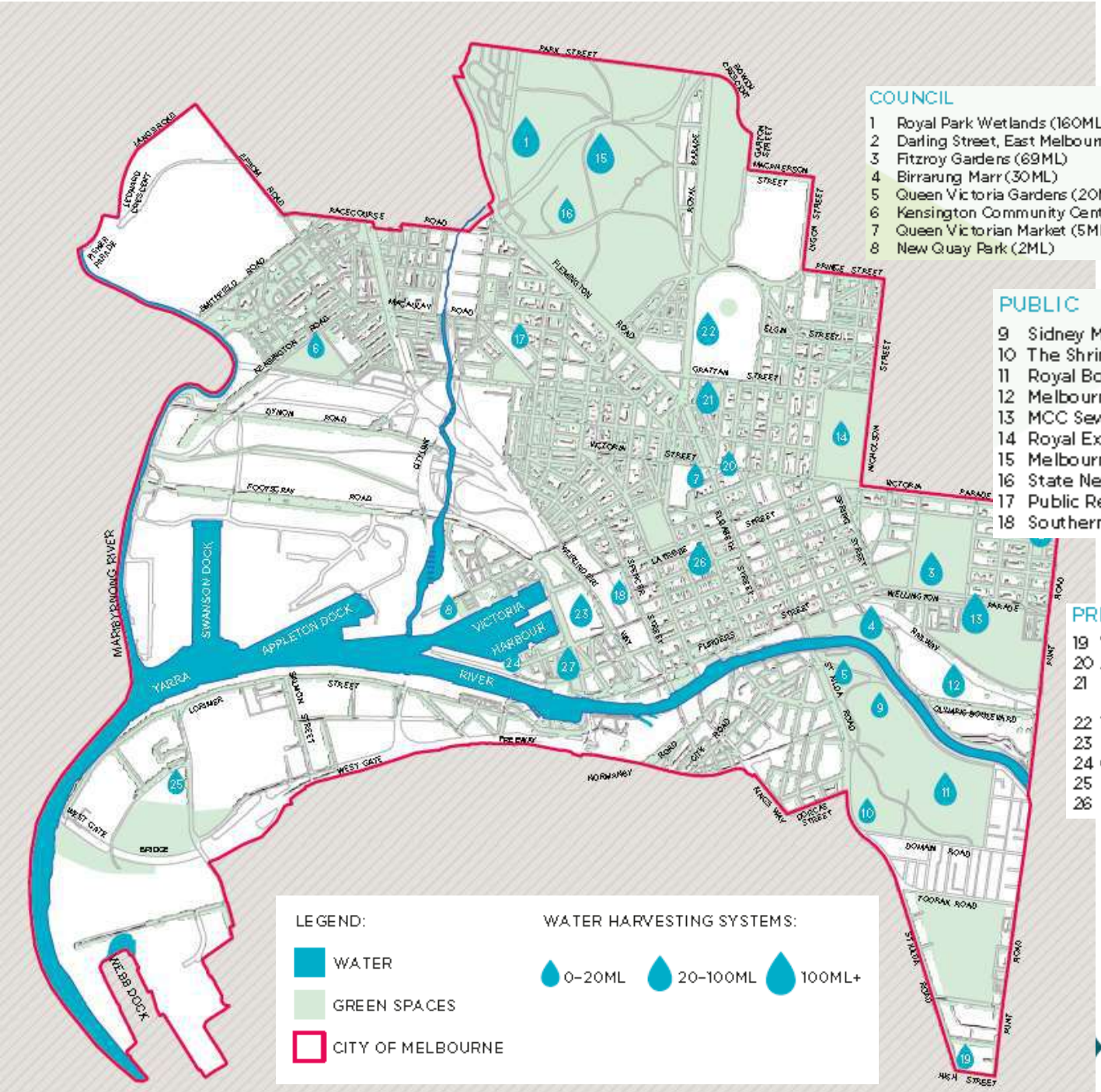

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水敏型城市—集中式分散式混合 – 悉尼中央公园

http://www.centralparksydney.com

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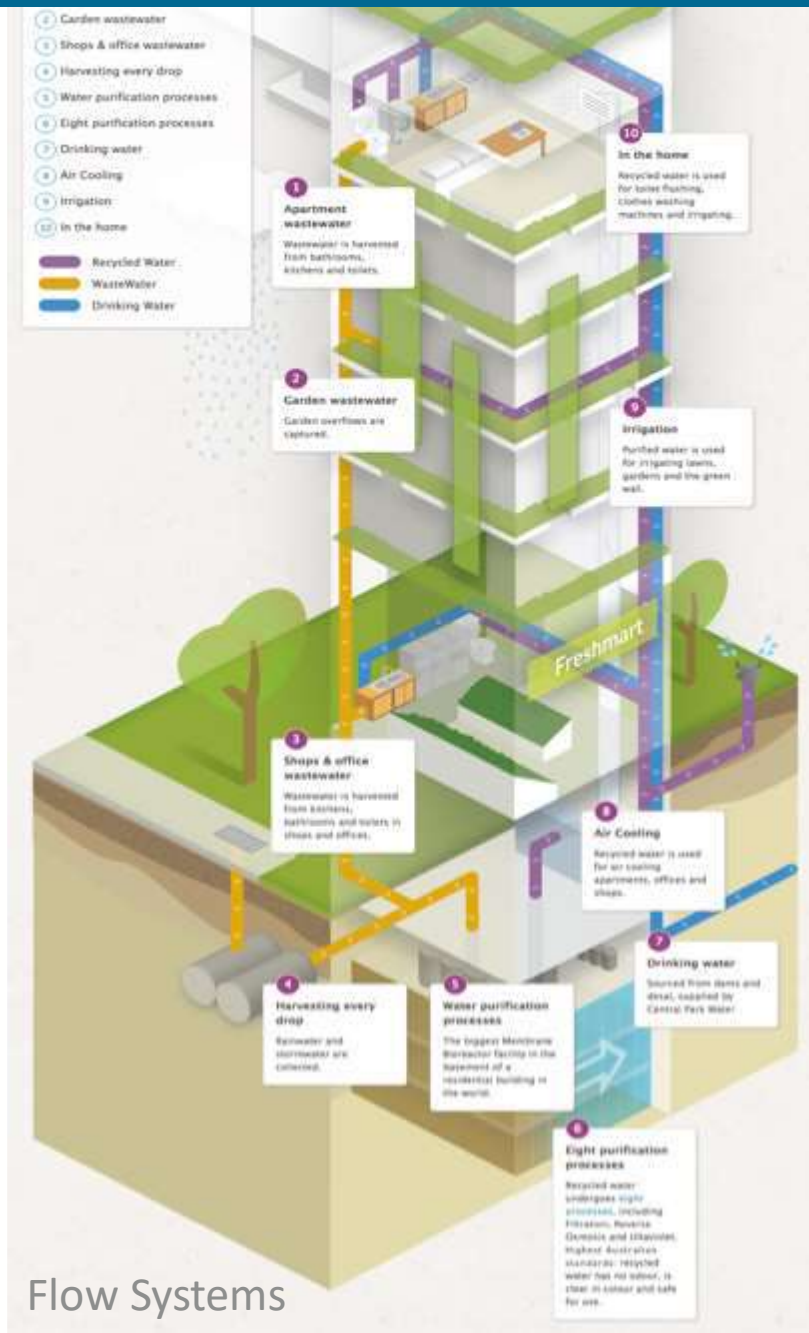
水敏型城市—集中式分散式混合 — 悉尼中央公园

- 5,000 常驻居民
- 15,000+ 每日 游客和工作人士
- 提供饮用水, 非饮用水, 污水收集和排污交易
- 每个房间的饮用水节约 40%-50%
- 非饮用水供给 洗衣、冲厕、景观浇灌、和制冷



水敏型城市—不仅仅是水！！

A whole-of-government approach will be necessary to harness the full potential of urban water management in delivering sustainable, resilient and liveable cities and towns

- 要迎接气候变化带来的挑战
- 建设城市水资源环境的战略安全
- 打造适宜居城市

(1)未来城市的发展和重建需要与水系统的规划相结合

(2)我们需要政府多个部门的联合努力和整体综合应对

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政府的机构的整体相应和机构改革

维多利亚宜居办公室
Office of Living Victoria

Role: Manage, Govern and Reform Urban Water
职责：对城市水务进行管理和改革

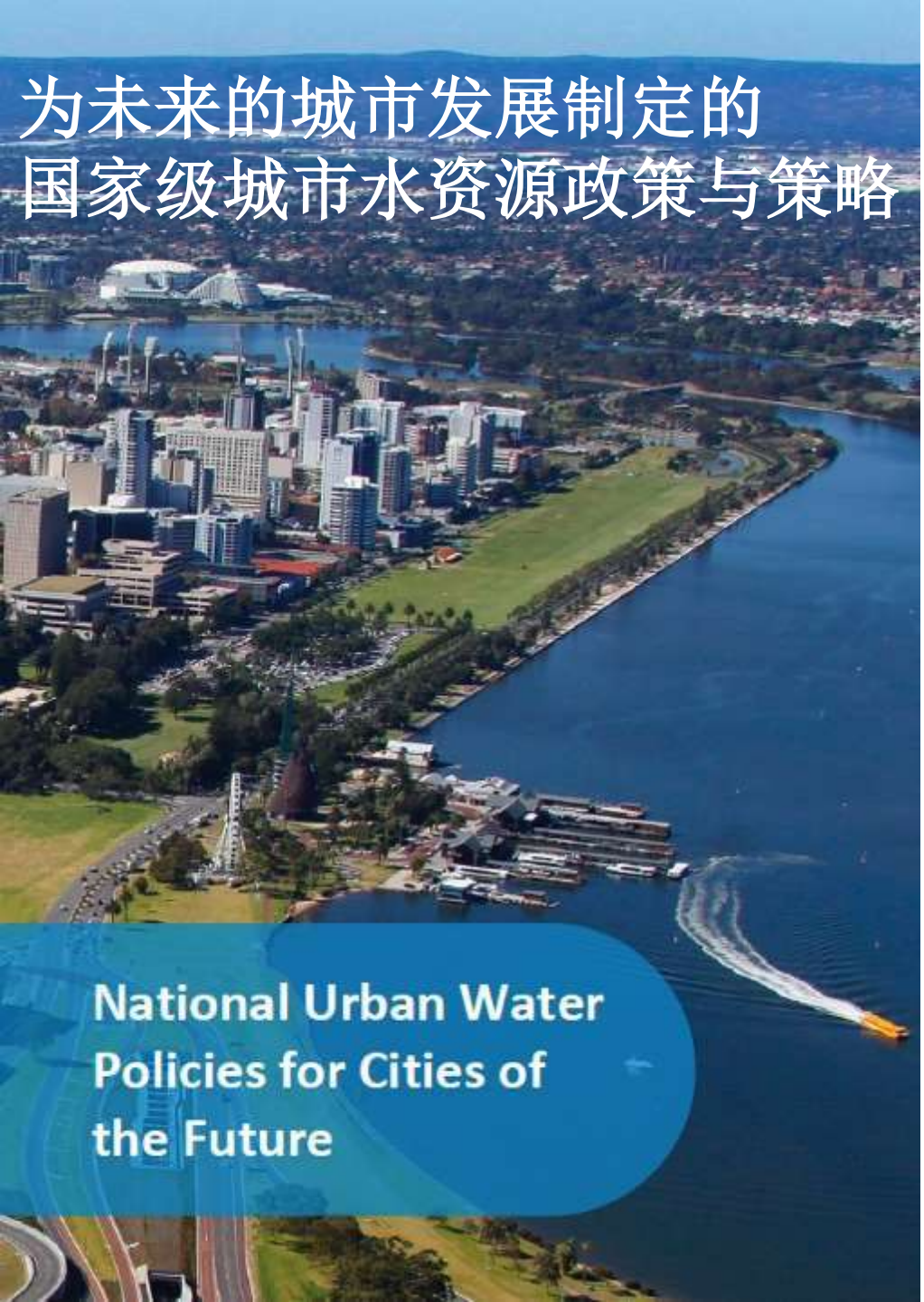
新加坡 宜居城市中心
Centre of Livable City

CENTRE for LiveableCities SINGAPORE

To distil, create and share knowledge on liveable and sustainable cities

CRC for Water Sensitive Cities

http://www.clc.gov.sg/



未来城市——水敏型城市

- integrate various sources of water;
  整合各种可利用的水资源
- operate through a combination of centralised and decentralised systems;
  通过一系列的集中式和分散式的系统来运行
- deliver a wider range of services to communities (e.g. ecosystem services, urban heat mitigation); and
  为城市社区提供一些列的服务（如生态系统的服务，城市热岛效应的减缓）
- integrate into urban design.
  与城市规划/设计的整合

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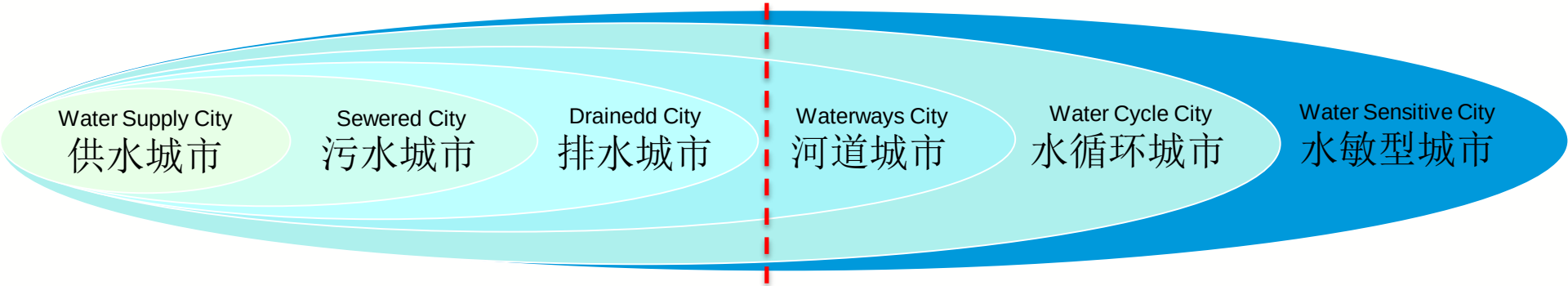
城市水环境的变迁史：过去现在和将来

Cumulative Socio-Political Drivers

Fit-for-purpose Water Production
水适其用式供给
- 集中式与分散式污水回收处理再利用
- 分散式雨水回收处理再利用

Resource Recovery from Sewerage Systems
从污水中回收资源
- 营养物质
- 能源



Waterway Restoration and Protection
河道保护与生态修复
- 雨水径流水质提升
- 洪峰流量控制
- 重新建立自然水文状态

Flood Management
雨洪管理
- 源头控制
- 雨洪滞留
- 通过蓝绿走廊作为行洪通道

Smart Sewers
智能污水管网系统
- 带压污水管网
- 实时控流与调度排放

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水敏型城市先驱城市

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澳大利亚水敏型城市研究中心 —— 《蓝图》2013

CRC for Water Sensitive Cities 提供城市应对和适应气候变化的解决方案

水敏型城市蓝图系列 —— 2013版

blueprint2013: Stormwater Management in a Water Sensitive City

Thank you 谢谢

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