

Stormwater use

Peter Rorke - ways of purifying and storing stormwater for potential use in landscapes and non-potable residential use

C o n s t r a i n t s

- S t o r m w a t e r h a s b e e n t r a d i t i o n a l l y s e e n a s a c o s t r a t h e r t h a n a r e s o u r c e
- P e a k f l o w s – a n a l a g o u s t o p e a k e l e c t r i c a l d e m a n d – n o t o f t e n r e q u i r e d t o b e m e t, b u t c a n b e s e r i o u s i f t h e y a r e n o t



The 1972 flood in Elizabeth Street, captured by Walkley Award-winning *Age* photographer, Neville Bowler

Storm water runoff

- Estimated to be 550GL in Melbourne per annum (SIAV, 28/4/06)
- Increasing with greater proportion of impervious areas (paving, etc)
- Peak flows will increase if, as expected, global warming leads to a greater incidence of extreme weather events

O t h e r e f f e c t s

- T h o u g h e v e r y e f f o r t i s m a d e t o s e p a r a t e s t o r m w a t e r f r o m s e w a g e f l o w s i n A u s t r a l i a n c i t i e s , s o m e s t o r m e v e n t s i n c r e a s e s e w a g e f l o w s b y u p t o 1 0 0 %
- S e w a g e l e a k a g e i n t o p o t a b l e w a t e r s y s t e m s m a y i n c r e a s e w i t h t h e s e i n c r e a s e d s t o r m w a t e r f l o w s

Cost vs opportunity

- Storm water as a cost
 - Infrastructure needed to deal with usual flows
 - Trade-off of peak flow capacity and cost
 - “On-Site Detention” (OSD)



Heatherdale Retarding Basin, Mitcham
20/12/07 (below peak of 2.8m)

O p p o r t u n i t y

- A u s t r a l i a ' s p e r c a p i t a w a t e r u s e 3rd h i g h e s t
i n t h e w o r l d (r e f : W a t e r R e c y c l i n g i n A u s t r a l i a , 2 0 0 4)
- P e r c a p i t a d o m e s t i c u s e i s 3 2 0 l i t r e s p e r
d a y
- H o u s e h o l d s – 5 9 % o f u r b a n w a t e r u s e
- 5 4 % o f t h a t – u s e d f o r g a r d e n w a t e r i n g o r
f l u s h i n g t o i l e t s
- O p p o r t u n i t y t o u s e l o w e r q u a l i t y c a p t u r e d
w a t e r ?

B e n e f i t s

- R e d u c e d u s e o f p o t a b l e w a t e r
 - I n c r e a s e d s e c u r i t y o f s u p p l y
 - P o s t p o n e n e e d f o r e x p e n s i v e w a t e r a u g m e n t a t i o n
 - I m p r o v e e n v i r o n m e n t a l f l o w s
 - M a i n t a i n p o t a b l e w a t e r f o r a p p r o p r i a t e n e e d s
 - M e e t w i t h c o m b i n a t i o n o f d e m a n d m a n a g e m e n t (w a t e r e f f i c i e n t a p p l i a n c e s , a p p r o p r i a t e g a r d e n s , b e h a v i o u r a l c h a n g e) a n d u s e o f n o n - p o t a b l e w a t e r w h e r e a p p r o p r i a t e

O v e r s e a s – o n e e x a m p l e

C a l i f o r n i a W a t e r C o d e :

- 13550 (a) “The Legislature hereby finds and declares that the use of **potable** domestic **water** for nonpotable uses, including, but not limited to, cemeteries, golf courses, parks, highway landscaped areas, and industrial and irrigation uses, is a waste of an unreasonable use of the **water** within the meaning of Section 2 of Article X of the California Constitution if recycled **water** is available which meets... conditions, as determined by the state board...”

O n -S i t e D e t e n t i o n v s R e t e n t i o n

- O S D – detains water to reduce peak flows in storm water system
- O S R – use of storm water for appropriate use on properties
- W h a t a r e i s s u e s ?
 - H e a l t h
 - R e g u l a t o r y
 - T e c h n i c a l

Health issues

- 2 potential types of hazards to humans in “wastewater”:
 - Microbial contaminants – present in faecal wastes, main priority is eliminating their potential to cause outbreaks of disease from short-term exposure
 - Various chemicals that can end up in wastewater, including pharmaceutical products, industrial and domestic chemicals

Storm water Quality

- Urban storm water quality is influenced by many factors, including population density, land use, relative proportion of impervious area, waste-disposal and sanitation practices, soil type, climate and local construction activity.
- In fact, wastewater, especially if treated, has a more consistent level of water quality than storm water (Ref:

<http://www.catchment.crc.org.au/pdfs/Industry199914.pdf>)

Parameters & pathogens

Physical parameters	Pathogens	
	Viruses	Bacteria
BOD , COD		
Total organic carbon	Enteroviruses	Shigella
Total organic halogens	•Poliovirus	Salmonella (typhi &
Suspended solids	•Echovirus	Vibrio cholerae
Compounds of	•Coxsackie A	Escherichia coli
Compounds of nitrogen	•Coxsackie B	E. Coli O157 H7
Dissolved oxygen	•Norwalk	Yersina enterocolitica
Hardness, pH, taste & colour, temperature	Hepatitis A Adenovirus	Leptospira Legionella pneumophila
Total Dissolved Solids	Rotavirus	Campylobacter jejuni
True Colour	Parvovirus, Reovirus	Protozoa
Turbidity	Astrovirus, Calicivirus	Helminths

Ref: Hamlyn-Harris, in Water Recycling in Australia, 2004

Other potential contaminants

- Inorganics (metals, ammonia)
- Organic compounds
- Pesticides
- Stormwater, even at a domestic level, may include a range of fertilisers, pesticides and faecal contaminants



DOGS
(FOULING OF LAND) ACT, 1996



IT IS AN OFFENCE NOT TO
CLEAN UP AFTER YOUR DOG
MAXIMUM PENALTY £1000

B u t t o k e e p t h i n g s i n p e r s p e c t i v e ...

- A u s t r a l i a n B u r e a u o f S t a t i s t i c s –
*Development of a risk assessment
approach for evaluating wastewater reuse
standards for agriculture (Ireland 2003)*
 - V i r u s f r o m r e c l a i m e d w a t e r p r o d u c e : 1 i n 1 0
m i l l i o n
 - H a v i n g y o u r c a r s t o l e n : 6 8 , 4 9 3
 - H a v i n g a s t h m a : 1 , 1 1 1 , 1 1 1

Health assurance in treated water



- Use of indicators such as e.coli
- Physico-chemical indicators (turbidity and pH) are not themselves health concerns but may indicate contaminants

Treatment systems

- Gross pollutant traps in larger scale systems (multi-residential developments, car parks, shopping centres)

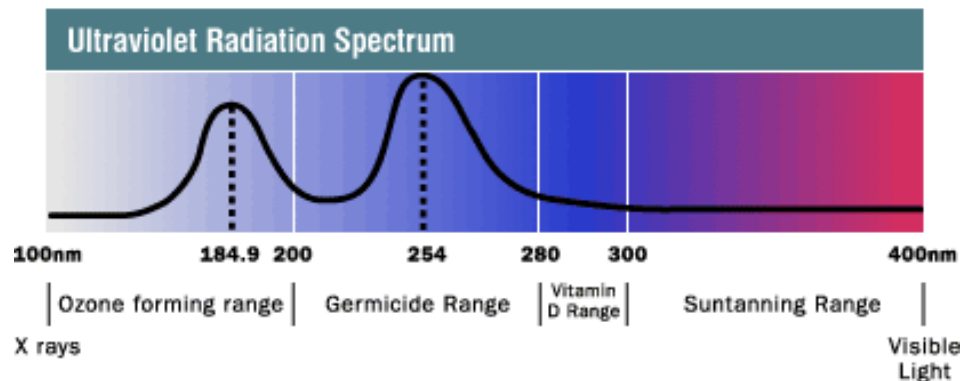


Treatment systems

- Swales – open vegetated (usually grassy) drains, providing filtration prior to discharge to downstream drainage systems or receiving waters
- Processes in swales are quite complex, involving hydraulic, physical and biochemical components
- One study showed 74% reduction in TSS from 35 metre length of swale

Treatment systems

- Natural attenuation of microbes can occur in storm water ponds – this capacity forms the basis of many treatment systems (WRIA, p126)
- UV light sterilisation (used in a variety of rainwater systems, e.g. 60L)



Options for storm water use

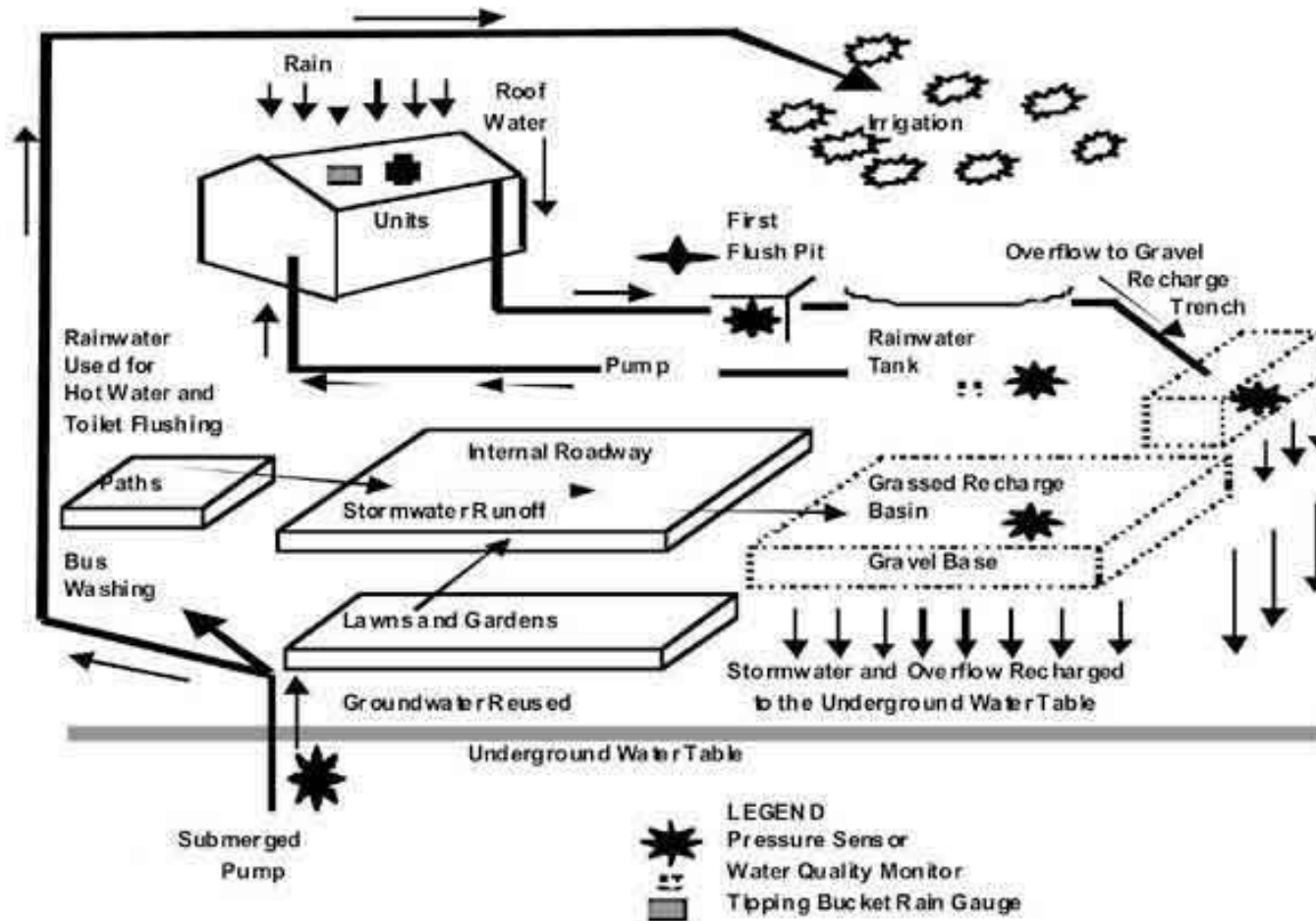
- On-site rainwater tanks
- Community collection & storage for irrigation
- Aquifer storage & recovery
- Habitat restoration (such as a wetland or stream)
- Treatment options and potential health ramifications will vary with use

Example – Homebush Bay, Sydney

- Storm water run-off from within Homebush Bay is treated using gross pollutant traps, swales and wetland systems. Wastewater is also treated using a water reclamation plant inside the complex.
- The treated storm water and wastewater are stored in a disused brick pit. The treated water is available and used as an alternative water supply for water features, irrigation purposes, toilet flushing and fire fighting within Sydney Olympic Park.
- Ref: <http://www.environment.gov.au/coasts/pollution/usi/newsletter-5.html>

Figtree Place, Newcastle

Overview of Figtree Place Water Sensitive Design Elements



B o l t o n R e s e r v e , B o x H i l l

- S t o r e s 1 , 0 0 0 , 0 0 0 l i t r e s o f t r e a t e d s t o r m w a t e r
- T r e a t s s t o r m w a t e r b y p a s s i n g t h r o u g h a G r o s s P o l l u t a n t T r a p a n d a s e d i m e n t a n d o i l t r a p
- F i l t r a t i o n b y p a s s i n g t h r o u g h a s u b s o i l f i l t e r
- U n t r e a t e d s a m p l e t a k e n 2 0 S e p t e m b e r 2 0 0 6 – B O D ₅, c o p p e r, l e a d, z i n c, s u s p e n d e d s o l i d s, e t c., w e r e a l l b e l o w E P A r e c o m m e n d e d l e v e l s
- T r e a t e d w a t e r w i l l b e s u i t a b l e f o r i r r i g a t i o n

B o l t o n R e s e r v e , B o x H i l l

- T r e a t m e n t s t e p s
 - G r o s s P o l l u t a n t T r a p
 - S e d i m e n t t r a p
 - O i l t r a p
 - S u b s o i l f i l t e r , c o m p r i s i n g m u l t i p l e l a y e r s o f i n e r t m e d i a m a t e r i a l
 - F i l t e r m e d i a (s a n d y l o a m)
 - T r a n s i t i o n l a y e r (c o a r s e s a n d)
 - D r a i n a g e l a y e r (c o a r s e g r a v e l)

B o l t o n R e s e r v e - s t o r a g e

- R a n d o m i n e r t m e d i a m a t e r i a l c o m p r i s i n g 20 a n d 25 m m s c o r i a w r a p p e d i n a g e o - t e x t i l e b l a n k e t , e n c l o s e d i n a w a t e r p r o o f m e m b r a n e
- C o s t - e f f e c t i v e s t o r a g e o p t i o n p r o v i d i n g 1 m i l l i o n l i t r e s o f s t o r a g e c a p a c i t y

Heatherdale Creek wetlands

- 980 m² ephemeral wetland
- Water passes through a series of filtration ponds that remove pollutants before entering storm water drains that feed Heatherdale Creek



E a s t l i n k w e t l a n d s

- 70 “constructed wetlands, water retention basins and bioretention strips”
- Capture and treatment of all surface runoff water from 39km of motorway
- Most of wetlands comprise 2 or more basins or ponds
- First – sediment trap
- Then, algae on water plant roots remove nitrogen and phosphorus from water

B a a r m u t h a P a r k , B e e c h w o r t h

- C a p t u r e s s t o r m w a t e r f r o m a n 8 1 -l o t s u b d i v i s i o n a n d f u t u r e r e s i d e n t i a l z o n e d l a n d i n t h e a r e a
- I n i t i a l l y c o n n e c t i o n t o i r r i g a t i o n s y s t e m a t s p o r t s o v a l
- L a t e r , c o n n e c t i o n s t o G o l f C o u r s e a n d B e e c h w o r t h S e c o n d a r y C o l l e g e

Regulatory issues – Victoria

- Storm water at household level
 - Approvals relate to collection and extraction of the resource rather than environmental or public health management with recycling
 - Best Practice Environmental Management Guidelines apply: Urban Storm water (C S I R O 1 9 9 9) and a range of specific guidance e.g. for construction sites
 - Available Guidance is focused on Water Sensitive Urban Design rather than environmental and health protection from recycling (R e f: W R I A , 2 0 0 4)

Regulatory encouragement

- B A S I X N S W

- Points-based system for measuring water and energy savings compared to a benchmark residence
- Water savings vary with location in the state (higher savings required on coast where there is higher rainfall)
- Points allocated for water efficient fittings and appliances, as well as rainwater tanks and storm water systems

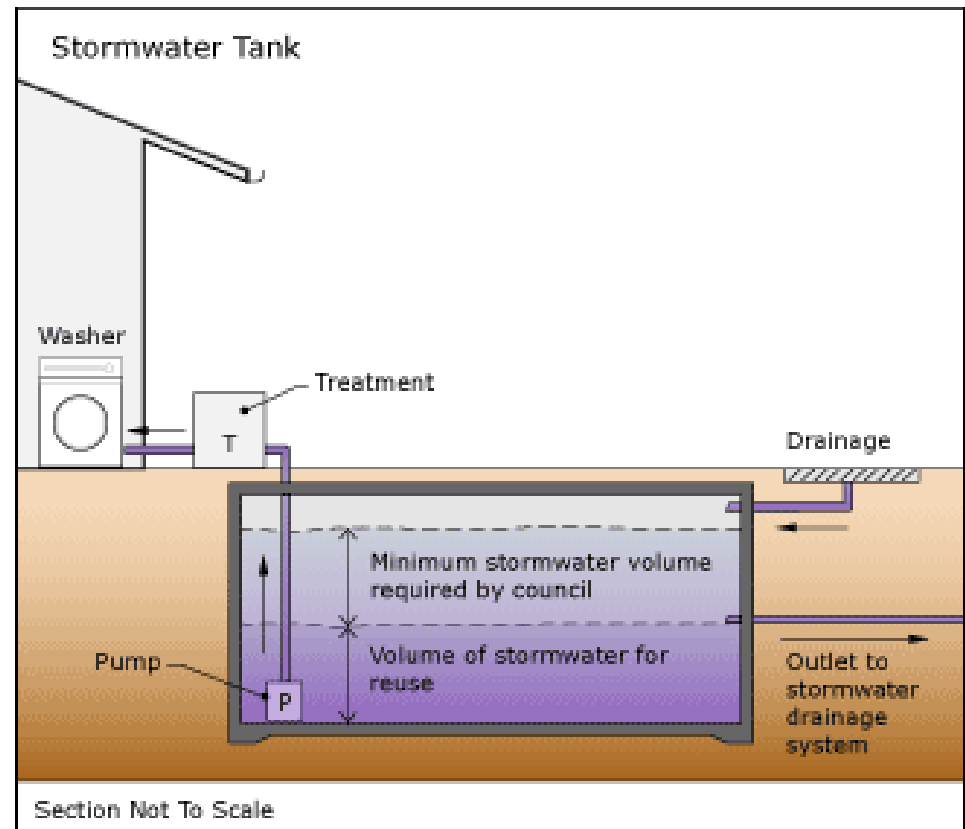
W h a t t o s p e c i f y i n B A S I X

How to measure the size of a stormwater tank

BASIX is only concerned with the stormwater tank size available for household reuse.

Additional stormwater volumes specified by your local council for 'onsite detention', must be in addition to the volume nominated as available for household storage and reuse in BASIX.

Ref:
<http://www.basix.nsw.gov.au/information/>
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Treatment steps in domestic systems

- Treatment prior to storage is similar to that used in larger systems
 - Gross pollutant trap
 - Filtration through vegetated swale
 - Filtering through coarse washed sand then through gravel
 - Final filtration might be through a geotextile fabric
 - Bacteria-generated “biofil” that traps and breaks down remaining pollutants

Factors in domestic system design

- Pollutant loads
- Pollutant and sediment minimisation (traps to prevent ingress or ability for removal)
- Water use
- Appropriate treatment options for use
- Additional on-site detention to reduce peak loads
- Pumping of water from storage to end use

C o n c l u s i o n s

- Storm water should be treated as a valuable resource rather than a cost
- Systems can integrate detention and retention aspects to reduce overflow events, and provide extra water resources
- Storm water quality can vary greatly
- Treatment prior to storage can comprise a combination of steps, some of which may be common to wetland systems and residential systems
- Regulations address more water sustainability issues rather than health issues
- Properly treated water will be suitable for gardens, toilet flushing or even laundry use, but not for drinking, bathing or cooking